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CHAPTER 5

CHROMITE DEPOSITS IN THE NORTHERN SIERRA NEVADA, CALIFORNIA

(PLACER, NEVADA, SIERRA, YUBA, BUTTE, AND PLUMAS COUNTIES)

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CHROMITE DEPOSITS IN THE NORTHERN SIERRA NEVADA, CALIFORNIA (PLACER, NEVADA, SIERRA, YUBA, BUTTE, AND PLUMAS COUNTIES)*

By Garn A. Rynearson **

OUTLINE OF REPORT

* Publication authorized by the Director, U. S. Geological Survey.

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ABSTRACT

More than 300 chromite deposits have been found in the northern part of the Sierra Nevada, or in that part included in Placer, Nevada, Sierra, Yuba, Butte, and Plumas Counties, California. By the end of 1949 these deposits had yielded approximately 32,000 long tons of ore, nearly half of which came from deposits in Placer County. Ore was shipped from a few deposits in the region as early as the early eighties, but about 85 percent of the total production is credited to the war years 1915-19 and 1941-45, when exploitation of the deposits was stimulated by higher market prices for chromite and lower specifications for acceptable ores. All the ore produced in the region during the postwar period 1946-50 was contributed by one deposit in Butte County.

The chromite occurs in ultramafic rocks, or in serpentine derived from them, and in detrital material resulting from weathering and erosion of such rocks. The numerous elongate and steeply dipping sill-like masses of ultramafic rocks of the region were intruded into metamorphosed Paleozoic and Mesozoic sedimentary and volcanic rocks during the early stages of the period of igneous activity that culminated in the intrusion of the batholithic masses of granitic rocks now forming the core of the Sierra Nevada. The striking linear distribution of the ultramafic masses along several north- to northwest-trending belts is a reflection of the regional structures of the older rocks. The largest of the masses, that constituting the principal member of the "great serpentine belt," is an essentially continuous mass more than 85 miles long and from a few hundred to more than 20,000 feet wide in outcrop. Nearly all the masses have undergone almost complete alteration to serpentine, but in most places the variety of the original rock can be recognized. However, some masses, notably those in the western part of the region, are so highly altered and sheared that the original characteristics of the rocks have been obliterated.

Two categories of chromite deposits are recognized in the region. Primary deposits are those that occur embedded in the original host rocks, and detrital deposits are those consisting of primary ore that has been more or less disengaged from the original host rocks by weathering and other erosional processes. Detrital deposits are in the minority but have contributed appreciable amounts of ore to the production of some areas. The more abundant and more important primary deposits consist of one or more ore bodies that occur as pods, lenses, or stringers of ore in or closely associated with the variety of ultramafic rock called dunite. Such ore bodies consist of two distinct but intergradational types of ore. Disseminated ore consists of chromite grains more or less dispersed in dunite; massive ore consists of a dense aggregate of chromite grains. The line of demarcation between the two types is arbitrary but, in general, ore containing more than 80 percent chromite is referred to as massive ore and ore containing less than 80 percent and more than 10 percent chromite is referred to as disseminated ore. Most ore bodies consist mainly of one type of ore, but some have components of both types. Deposits of massive ore in the northern Sierra Nevada range from only a few tons to a maximum of possibly more than 3,500 long tons. One deposit may contain more than 3,500 long tons of ore, five deposits have been found that contained more than 1,000 long tons, but most contain less than 100 tons. The largest deposit of disseminated ore in the region may hold about 20,000 long tons of ore containing 5,000 to 6,000 tons of chromite, but most contain only a few hundred tons of ore.

The tenor of the ore in different deposits has a wide range. Of the deposits for which the tenor of the ore is known, 34 percent consist of ore containing more than 45 percent Cr_2O_3, 47 percent consist of ore containing between 30 and 45 percent Cr_2O_3, and 19 percent consist of ore containing less than 30 percent Cr_2O_3. Most of the deposits that have yielded ore containing more than 45 percent Cr_2O_3 occur in the "great serpentine belt," whereas most of those whose ore contains less than 35 percent Cr_2O_3 occur in the westernmost ultramafic masses. Almost all the ores that contain less than 40 percent Cr_2O_3, including concentrates made from low-grade disseminated ores, have Cr to Fe ratios less than 2.5.

Most of the known chromite deposits in the northern Sierra Nevada appear to be worked out because little or no ore is exposed in the workings. Consequently, the total amount of massive ore or disseminated ore containing more than 35 percent Cr_2O_3 that can be measured in the deposits is relatively small. The indicated ore reserve of several deposits in which appreciable amounts of ore is exposed are estimated to be of the order of 1,000 to 2,000 long tons. With one notable exception, the known deposits of low-grade disseminated ore appear to be too small or too difficult of access to justify milling operations; the excepted deposit is much larger and is more favorably located and might yield 5,000 to 6,000 long tons of high-iron chromite concentrate. The dumps of many widely scattered deposits contain at least a few tons of chromite fragments, and perhaps as much as several thousand tons of acceptable concentrate might be recovered by reworking a large number of the dumps with some simple type of portable concentrator.

Additional prospecting in the ultramafic rocks of the region probably will be rewarded with the discovery of a few virgin deposits, but the major part of any future production will likely come from deposits that have been worked previously. In the writer's opinion, many of these deposits still contain as much or more ore than has been taken from them in the past. A large part of this report is devoted to descriptions, by counties, of most of the known deposits. Many data on the production of individual deposits are given because the past production of a deposit may be the prime factor on which an appraisel of its potentialities can be based. Some deposits appear to be more promising than others, but only by actual exploration can the presence or absence of additional ore bodies be determined, and several criteria that may help to orient such exploration are discussed in the text. If sufficient incentive is provided to encourage thorough exploration of the known deposits and additional prospecting for virgin deposits, it is conceivable that the future production of chromite in the region might approximate the past production.

INTRODUCTION

Geographic Features. The chromite deposits described in this report include those of Placer, Nevada, Sierra, Yuba, Butte, and Plumas Counties, California—the six counties that embrace the northern part of the Sierra Nevada (see fig. 1). The region under consideration is

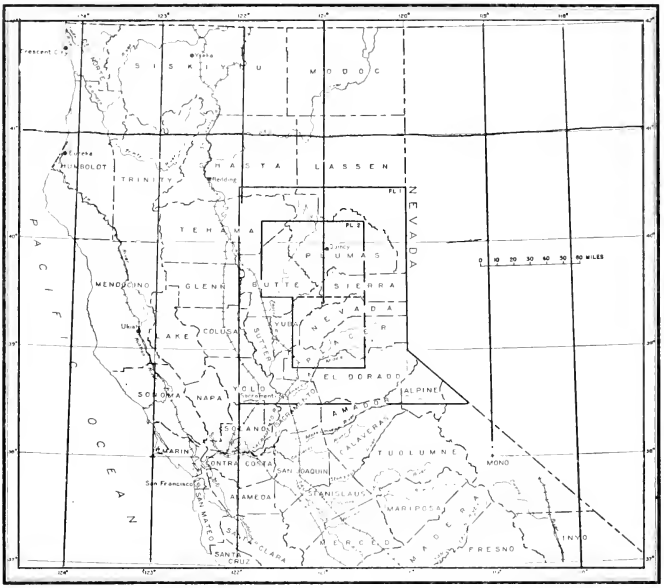

FIGURE 1. Index map of northern California showing the relative locations of Placer, Nevada, Sierra, Yuba, Butte, and Plumas Counties and areas covered by plates 12 and 13.

bounded on the west by the Sacramento Valley, on the north by the Cascade Range, on the east by the Basin Ranges province and the State of Nevada, and on the south by the Middle Fork of the American River and El Dorado County. Most of the chromite deposits occur within a belt 20 to 30 miles wide trending north to north-northwest through the west-central part of this block of counties. As a group, the deposits have yielded approximately 32,000 long tons of ore, an amount representing about one-twelfth of the total chromite production of California.

Dominating all other topographic features of the region is the fault block of the Sierra Nevada. This block emerges from the plains of the Sacramento Valley as a strip of foothills 1,000 to 2,500 feet high and slopes gently upward to the east in a series of even-topped ridges separated by deep canyons to the glaciated and subalpine peaks of the crestline, and then drops off steeply to the valleys separating it from the adjoining province. The eastern slope of the Sierra Nevada in this region is not nearly as precipitous and spectacular as the escarpment farther south, partly because the summit elevations are several thousand feet lower, with only three peaks ascending to 9000 feet, and partly because the bordering structural and erosional valleys are smaller and more irregular. However, the western slope in this region, its relatively regular surface scored by numerous deep, V-shaped canyons extending westward or southwestward from the summit, is quite similar to that farther south.

A good system of Federal, State, and County highways serve the more populous areas bordering the mountainous parts of the region, and three major and several subordinate highways traverse the range. In addition, the mountainous part of the region has a substantial network of connecting county, forest, timber, and mine roads that extend into all but a few of the wilder and almost inaccessible areas. Most of these secondary roads are unsurfaced and those that depart from the ridge tops or the canyon bottoms usually are steep and tortuous; nearly all are virtually impassable during wet weather or after the winter snows have fallen. The main line of the Western Pacific Railroad traverses the northern part of the region through the Feather River canyon with spur lines to Quincy, Westwood, and Calpine. The Ogden route of the Southern Pacific Railroad traverses the southern margin and is connected at Colfax with a narrow-gauge line from Nevada City. A branch line of the same company extends northward along the eastern margin of the Sacramento Valley with connecting spurs to Oroville and to Stirling City. Therefore, the transportation system of the region provides ready, fair-weather access to nearly all points, but the travel pattern is oriented mainly east and west parallel to the topographic "grain," and travel between most points situated north and south of each other can be accomplished only by long and devious routes.

The region has a diversified climate that varies with the elevation of the land, as well as with the seasons. Except for a few thundershowers, the summers are dry and are very hot in areas below an altitude of about 5,000 feet but somewhat cooler in higher areas. During the winter, heavy snows blanket much of the high eastern half of the region, whereas the western half receives little or no snow but gets a moderate rainfall. Mining can be carried on at most of the chromite deposits throughout the year, although surface workings are difficult to maintain and hauling is all but impossible during wet weather. Water is available in all the larger canyons, but the supply is scarce on the tops and upper slopes of the ridges, especially during the summer. Much of the mountainous part of the region is forested and supports a large timber industry. Mining timbers, therefore, are readily obtained either from standing trees or from one of the numerous sawmills.

Scope of Report and Acknowledgments. As part of a nation-wide investigation of strategic minerals, the Geological Survey, U. S. Department of the Interior, made extensive field studies of chromite deposits in California during the period 1938-44. These studies were carried on under the supervision of F. G. Wells. Prevailing emergency conditions required that priority be given those deposits and areas that seemed to have the greatest production potential, and the demands thus imposed on the limited Survey personnel available prevented a systematic examination of all the deposits in California. Consequently, many of the known deposits in the northern Sierra Nevada could not be visited, but some of the operating properties and a few of the inactive properties were examined by D. H. Dow, F. W. Gros, G. A. Rynearson, and F. G. Wells in 1941, 1942, and 1943. A subsequent decision to prepare a comprehensive report on the deposits of the region made it desirable to obtain additional field information on some deposits, and Rynearson therefore made brief examinations of many of those in Placer County and a few in Butte County during parts of 1949 and 1950.

This report is based partly on the results of the above work and partly on published and unpublished data gathered between 1916 and 1918 by R. C. Cameron and Harry Thompson for the U. S. Bureau of Mines, N. L. Taliaferro for the California State Council on Defense, and C. V. Averill, C. A. Logan, C. A. Waring, and other engineers of the California Division of Mines. Supplemental information has been obtained from other unpublished Federal and State records, scattered references in the literature, private records, and various other sources. Although many of the data available are incomplete and obviously out of date, an attempt has been made to select all the pertinent information and publish it in one report.

At the end of the description of each deposit the source of information is indicated by the name of the person reporting, followed by the last two figures of the year in which the report was made. All published and some unpublished reports to which reference is made are listed under "References" at the end of this report.

Many persons have contributed generously of their time and have provided much valuable information during the various phases of this investigation. Especially helpful were J. C. Akin, C. H. Brown and Jerry Grant of the Victory Chrome Co., Joseph Del Mue, C. A. and H. A. Geisendorfer, Lillian Graham, R. F. Helmke, R. N. Knudsen, D. L. Sullivan, and personnel of the California Division of Mines, the Capital Co., and the Southern Pacific Land Co.

History of Mining. Long famed for its rich lode and placer gold deposits, the northern Sierra Nevada is but little known for its numerous though small chromite deposits. The occurrence of chromite in the region was reported by J. B. Trask (53) in the early 1850's. Many of the deposits, or at least the float from them, must have been noticed but passed up by some of the thousands of prospectors who combed the hills in the fifties and sixties in their search for the more lucrative yellow metal. It was not until the early eighties that the first chromite was produced; this was in Placer County to supply a short-lived demand for refractory material to line the furnaces of a local iron smelter. About 1905 a deposit of "magnesian chromite" was opened in Sierra County; the ore from this deposit was shipped for furnace linings also. Large-scale exploitation of the deposits has been limited to the war years 1915-19 and 1941-45, when both the price and the demand were high enough to stimulate production. About 85 percent of the chromite yielded by the deposits was produced during these two periods. With but few exceptions the chromite miners have been unable to mine and sell their ore at a profit in the peacetime markets.

Historical highlights of local chromite activities are described in the sections of this report devoted to individual counties.

Production. Accurate and reliable production figures for many of the deposits in the northern Sierra Nevada are not available in the form of official records except for the period 1942-45, when the Metals Reserve Co. purchased all the ore sold, and even for this period the actual production of individual deposits often cannot be ascertained from the data recorded. The importance of knowing the actual production of a chromite deposit, especially a relatively small one, generally is underestimated. A record of the amount of ore taken from a deposit has scientific value in

that it indicates the size of the ore body or bodies, which is of considerable geologic interest. The record also has economic importance in that it may help considerably in appraising the future possibilities of the deposit, and could be the deciding factor in encouraging additional exploration of a deposit that has been considered worked out because no ore shows in the workings. Almost 90 percent of the ore produced in the region during World War II came from deposits that had been worked previously; lacking as yet a reliable guide for predicting the presence of ore bodies that have no surface expression, it is probable that a large part of any future production will come from ore that may remain in or near known deposits. To this purpose, many data on the production of individual deposits will be given in the various sections of this report. However, any of these data are based on information of varying reliability, and some explanation of the shortcomings and interpretation of the source material seems necessary.

The official chromite production statistics, both Federal and State, are for the most part compiled from reports received from mine operators or ore buyers. The Geological Survey or Bureau of Mines and the California Division of Mines have received reports from most of those who have produced or purchased ore in the region since 1915, but the reports received by each agency have not always agreed, even when submitted by the same person. The production for some deposits was not reported and for others, the figures are inaccurate. Some production has been duplicated in the records because two or more operators, or the operator and an ore buyer, each have submitted reports without indicating the identity and exact location of the deposit or without specifying the separate amounts and sources when the production was for more than one deposit. Federal production figures have been compiled in long tons, whereas the State figures have been compiled in short tons. Some discrepancies in the records can be attributed to erroneous assumptions made when the reports received did not specify the kind of ton measured. Some discrepancies of this kind have been recognized and corrected for this report, and figures reported in short tons have been converted to long tons unless otherwise stated. Since 1919 the State has recalculated the reported tonnages to equivalent amounts of ore containing 45 percent Cr_2O_3. Thus, 100 tons of ore containing 50 percent Cr_2O_3 has been recorded as 111 tons, and the same amount of ore containing 40 percent Cr_2O_3 has been recorded as 89 tons. Inasmuch as such figures do not represent the amount of ore actually mined and shipped, all post-1918 State figures used in this report have been reconverted to their original form.

Detailed production data, by deposits, are given in descriptive and tabular form in the sections devoted to separate counties. These data have been gleaned from all available sources, including published and unpublished records and reports, private records, and first-hand information furnished the writer by numerous mine owners and operators or others familiar with the mining operations. Unless otherwise indicated, the figures shown in the main body of each table were derived from the records used to compile the annual volumes of "Mineral Resources of the U. S." and "Minerals Yearbook." Figures representing the combined production of two or more deposits have been apportioned whenever possible. Despite attempts to recognize and eliminate discrepancies

*Table 1. Chromite production, by counties, from the northern Sierra Nevada, California (in long tons)**

Year	Placer	Nevada	Sierra	Yuba	Butte	Plumas	Total
Pre-1916	2,900	(**)	(**)	—	37	—	2,937+
1916	646	886	135	—	1,344	94	3,105
1917	2,755	1,089	83	—	1,369	160	5,456
1918	3,383	2,178	905	—	1,754	125	8,345
1919	1,166	980	67	—	—	—	2,213
1920–40	679	60	—	—	—	20	759
1941	1,547	—	102	—	(**)	198	1,847+
1942	1,422	50	125	39	196	317	2,149
1943	484	16	272	—	317	512	1,601
1944	447	20	47	—	78	77	669
1945	148	—	—	—	22	—	170
1946–49	—	—	—	—	1,222	—	1,222
Totals	15,577	5,279+	1,736+	39	6,339+	1,503	30,473+
Estimated totals***	15,620±	5,500±	2,380±	39	6,785±	1,486±	31,810±

* Compiled mostly from official Federal and State records.
** Small production, amount not known.
*** Estimates based on information obtained from all available sources.

and duplications, some figures undoubtedly are inaccurate; some may be too high and others too low. To illustrate differences between these compilations and the official compilations, Federal and State totals for production prior to 1941 are given separately. Also, columns showing estimated production have been included in the tables. The figures in these columns represent an appraisal of all information available, and, though not official, they are believed to be more representative of the actual production. Table 1 summarizes, by counties, the production data given in tables 6 and 9 to 12.

GEOLOGY

General Features

The general geologic features of the whole of the northern Sierra Nevada have been mapped; the principal contributions were made by Waldemar Lindgren, H. W. Turner, and J. S. Diller, in some of the early geologic folios and other publications of the Geological Survey (see "References"). Later and more detailed work in a few relatively small areas by H. G. Ferguson and R. W. Gannett, W. D. Johnston, Jr., N. L. Taliaferro, and others has shown the geology to be much more complex than depicted on the early maps, and an enormous amount of geologic work remains to be done before the complicated stratigraphy and structure of the region can be understood fully.

Neither space nor purpose permits a detailed and comprehensive account of the regional geology in this report, but a brief summary of

the major geologic units and events is given to provide the reader with a setting for the occurrence of the ultramafic rocks and associated chromite deposits, which are described in some detail. Plate 12 shows the geology of the region in a generalized form; the small scale of the map precludes showing the individual geologic formations even where these have been differentiated. Although abandoned for use in publications of the Geological Survey, the names "Bedrock series" and "Superadjacent series" have been widely used to denote the two principal groups of Sierra Nevada rocks and will be retained here because they are particularly applicable to the generalizations made in this summary and on plate 12.

The history of the Sierra Nevada began in the Paleozoic era with the accumulation of a thick sequence of shales, sandstones, cherts, and limestones, together with some volcanic flows and shallow intrusives. Paleozoic formations ranging in age from Silurian to Permian have been identified in the Taylorsville area, but elsewhere the rocks have been grouped together and mapped as the Calaveras formation on the supposition that the great bulk of them are of Carboniferous (Mississipian) age. Units corresponding to parts of the Calaveras have been segregated and named in the northeastern part of the region and in the Colfax quadrangle in the southern part, but these units have not yet been correlated definitely or traced across intervening areas. The Calaveras formation, as mapped, probably includes some pre-Carboniferous rocks and perhaps some early Mesozoic rocks as well, and the name Calaveras, therefore, has no stratigraphic significance. The Paleozoic rocks were dynamically metamorphosed to phyllite, quartzite, recrystallized limestone, and amphibolite schist during a period of intense folding and uplift at the close of the era.

The beginning of the Mesozoic era is marked by a period of erosion and the eventual submergence of the Paleozoic terrain, after which another thick sequence of sedimentary and volcanic rocks were accumulated. These rocks are represented by several Triassic and Jurassic formations in the Taylorsville area, the Milton (Jurassic?) and Sailor Canyon formations (Jurassic) in the eastern part of the region, and the Amador group (Middle and Upper Jurassic) and Mariposa slate (Upper Jurassic) in the western part. The Amador group is best developed in the central Sierra Nevada and apparently is overlapped by the Mariposa slate a little north of the Middle Fork of the American River. Widespread volcanic activity during and immediately after the deposition of Mariposa sediments is evidenced by extensive areas of andesitic flows and shallow intrusives now exposed mainly in the western part of the region. This volcanism heralded the intense igneous activities accompanying the Nevadan orogeny to which the whole of the region was subjected to late Jurassic and early Cretaceous time. The Nevadan orogeny began with a period of intense folding accompanied by the intrusion of masses of ultramafic and gabbroic rocks. It culminated in the invasion of all the pre-existing rocks by great masses and small dikes of plutonic rocks, ranging in composition and general sequence from hornblende gabbro and diorite to granodiorite, and subsided with the formation of the gold-quartz veins. Except for local contact metamorphism, the pre-existing sedimentary rocks were only slightly metamorphosed by the orogenic processes. Most of the volcanic rocks, however, were converted to greenstone or amphibolite schist.

Thus, before the Cretaceous period the formation of the rocks constituting the "Bedrock series" of the Sierra Nevada was completed and the stage was set for the formation of those constituting the "Superjacent series." Erosion was the dominant geologic process during the Cretaceous period. Thousands of feet of "Bedrock series" were removed and the debris was deposited in the marine basin to the west. The granitic core of the Sierra Nevada was uncovered over large areas, and the region as a whole was reduced to a lowland. Sedimentary deposits of the Upper Cretaceous Chico formation were laid down, as the oldest formation of the "Superjacent series."

In the Eocene epoch the Sierra Nevada was uplifted again and tilted westward, deep valleys were cut by the rejuvenated streams, gold from the eroded veins was concentrated in the stream gravels, and the widespread volcanic activity of the Tertiary period began. A large part of the Eocene volcanics and some of the gravels were removed during Oligocene time, but in Miocene time recurrent outpourings of andesitic materials, interrupted by short intervals of erosion, buried the older rocks under a thick volcanic mantle. Marine and nonmarine sedimentary deposits were laid down in the basin to the west, but their margins barely lapped the western flanks of the Sierra Nevada.

Volcanism continued north of the region through Pliocene into Pleistocene time and added to the volcanic mantle at the northern and northwestern extremities of the range. In late Tertiary and early Quaternary time the Sierra Nevada was uplifted and tilted westward once more; concurrent and subsequent faulting produced the eastern escarpments of the block. Since then, the rivers and streams, aided for a while by Pleistocene glaciers, gradually have removed the volcanic mantle from most of the region and by now have carved their courses deep into the underlying "Bedrock series."

Ultramafic Rocks

Chromite occurs in many kinds of rocks as a minor accessory mineral, but it is an important primary accessory only in ultramafic rocks or in serpentine derived from them. Furthermore, the Geological Survey's recent investigations of chromite deposits in California have indicated that important primary concentrations of chromite occur only in the variety of ultramafic rock called dunite. Recognition of this fact has proved helpful in studying the deposits and can be of considerable aid in exploiting them. Field identification of dunite as well as other varieties, therefore, is of particular importance. The characteristics that distinguish the principal varieties of ultramafic rocks in the northern Sierra Nevada are given in the following paragraphs, along with descriptions of their alteration, structure, and distribution.

Lithology. Ultramafic rocks are composed chiefly of olivine and pyroxene, with little or no feldspar, and contain accessory chromite or magnetite. Those without feldspar are commonest and are known by the group name peridotite. Because olivine and pyroxene are readily altered to the various serpentine minerals, masses of peridotite commonly are altered extensively to serpentine, and the geologist and layman alike frequently refer to them as serpentine. Most previous investigators of the chromite deposits have referred to the enclosing rocks by the general term serpentine. The writer follows suit, in this report, when using such

references without benefit of more specific information, but he prefers to reserve the name serpentine to denote ultramafic rocks that have been so altered that their original character cannot be determined by visual inspection. Whenever known, the varietal name of the original rock is used, even though the rock is completely serpentinized, and the term peridotite is used to denote undifferentiated rocks whose general physical appearance still resembles that of the original rocks.

Peridotite can be differentiated into several varieties on the basis of mineral composition. The olivine-rich variety, containing more than 95 percent olivine and little or no pyroxene, is called dunite; whereas the pyroxene-rich variety, containing more than 95 percent pyroxene, is called pyroxenite. Rocks containing intermediate proportions of olivine and pyroxene are called saxonite, wherlite, or lherzolite, depending on whether the pyroxene they contain is enstatite or diallage, or both. The several varieties evidently have genetic as well as mineralogic differences, and contacts between them usually are rather sharp. Saxonite is by far the most abundant variety in the northern Sierra Nevada, but dunite and pyroxenite are common; wherlite and lherzolite may occur, but neither has been reported.

Dunite, saxonite, and pyroxenite are distinguished from one another in the field mainly by the lack of or relative abundance of pyroxene, and their identification usually is not difficult unless all evidence of pyroxene has been obliterated by intense alteration or shearing. In fresh peridotite, pyroxene is distinguished from olivine by its more perfect cleavage. Olivine generally alters to antigorite, which has a rather uniform, fine-grained texture and weathers to a smooth surface. On the other hand, enstatite usually alters to bastite, which retains the characteristic pyroxene cleavage and resists weathering to a greater degree than antigorite. Thus, weathered surfaces of moderately altered saxonite are studded with silvery or bronze-colored bastite pseudomorphs in relief. The preponderance of weather-resistant pyroxene or bastite in pyroxenite gives it a characteristically rough surface, which distinguishes it from the smooth-surfaced dunite and the studded saxonite.

Both saxonite and dunite are dark grayish-green to black on freshly broken surfaces; altered saxonite may be mottled in the weathered zone by dark remnants of enstatite in a lighter matrix of antigorite. Weathering of both rocks liberates iron oxide, which colors exposed surfaces a reddish-brown. Exposed outcrops of dunite commonly have a buff color and are lighter colored than outcrops of saxonite.

In general, the soils on peridotite are thin and support a relatively sparse and somewhat restricted type of vegetation. In areas of low relief, however, a thick mantle of red or ocherous residual soil may accumulate and, in time, this soil will support a heavier and more diverse growth.

It should be noted here that the dikes and the reeflike masses of diorite and light-colored rodingite (garnet-diopside rock) associated with some peridotite masses are not varieties of the ultramafic rocks. They are slightly younger and contain no chromite.

Alteration. All the ultramafic masses in the region are more or less serpentinized, especially along fractures, faults, shear zones, and contacts. Nevertheless, much of the rock has retained its original physical appearance, and parts of some masses seem to be quite fresh. In general, the masses along the western margin of the region have been more thor-

oughly serpentinized than those elsewhere. Many of these, and a few small masses elsewhere, have been so completely serpentinized and otherwise altered and sheared that the rock can be referred to only as serpentine. Such rock has a greenish-gray to black color and weathers to lighter shades of green and gray. It is relatively incompetent and fractures easily into irregular blocks having smooth, waxy, slickensided surfaces. Where thoroughly sheared, it is a mass of glistening ellipsoidal to scale-like particles and is called "slickentite."

Most of the serpentinization probably took place at an early stage, during or not long after intrusion of the masses. Subsequent alterations, notably along faults and shear zones, in the vicinity of quartz veins, and at contacts with later intrusive rocks, have developed talc, tremolite, ankerite, magnesite, and chlorite or clinochlore in the rocks. However, the alteration to silica-carbonate rock, which is so common in ultramafic rocks of the Coast Ranges, has not been noted. Small deposits of soapstone, magnesite, and amphibole asbestos have been formed in the rocks by these alterations, and a few have been mined on a small scale.

Structure and Distribution. Areas underlain by ultramafic rocks are usually conspicuous in the field, and it is probable that all the large masses and most of the small masses have been delineated on the various geologic maps that cover the region. Some small masses have not been mapped, and the general locations of a few are indicated on plate 13 by unbounded location symbols for chromite deposits. The distribution and outlines of the masses that have been mapped are shown on plates 12 and 13. Plate 12 shows their distribution with respect to other groups of rocks in the region, whereas plate 13 shows their outcrop outlines in more detail. It should be noted that much of the mapping done in the region has been of a reconnaissance type and many ultramafic masses are far more complex in outline than shown on plate 13. Furthermore, it was the custom to group all kinds of serpentinized rocks together at the time most of the mapping was done; therefore, some areas represented as ultramafic rock on the two plates include undifferentiated bodies of partly serpentinized gabbro, a rock that is closely associated with the ultramafic rocks but is presumed to be slightly younger, as well as some talc, chlorite, and amphibole schists that may have been derived from less mafic rocks.

The ultramafic masses vary in size and shape. The smallest masses may be only a few tens of feet wide and less than 100 feet long, whereas the largest, that one constituting the principal member of the "great serpentine belt," is an essentially continuous mass more than 85 miles long and a few hundred to more than 20,000 feet wide in outcrop. Most of the masses are tabular or lenticular and appear to be sill-like in their contact relations with enclosing rocks, but some are highly irregular in shape and definitely crosscut the structures of the older rocks.

Without exception, the masses have been sheared and faulted to a greater or lesser degree. The borders of nearly all masses have been sheared, in places to wide zones of "slickentite," and some small masses have been sheared to "slickentite" throughout. A few masses with weathered surfaces appear to have relatively massive and unbroken interiors, but in the steep walls of some canyons, where the rocks are bare and devoid of soil and vegetation, it can be seen that the masses are fractured into countless subangular blocks, both huge and small, which

have been jostled between numerous shear zones and minor faults. Most shear zones and faults are roughly parallel to the contacts in small, narrow masses, but may have almost any direction when well within the largest masses.

Most geologists who have attempted to work out the geologic history and structure of the western Sierra Nevada agree that the ultramafic masses underwent at least part of the folding imposed on the pre-Mariposa rocks during the early stages of the Nevadan orogeny. However, it is by no means clear to what extent this period of folding influenced the distribution pattern of the ultramafic rocks. The outcrop outlines of some masses, for example, the sinuous body east of Downieville, suggest that the masses either have been folded or were intruded into folded structures. The probability that the major masses were intruded along fault zones does not preclude the possibility that some parallel masses may represent the truncated limbs of folded sills or sills that were intruded into pre-existing folds in the older rocks. Such an explanation is given in a geologic section by Taliaferro (43)* to account for similar parallel and bifurcated masses in the central Sierra Nevada. The arcuate flexure in the pre-granite rocks between the North Fork and the South Fork of the Feather River does not appear to be related to the early periods of folding; it may have been caused by the intrusion of the satellitic batholith of granitic rocks underlying that part of the region.

The conspicuous linear distribution of the ultramafic rocks obviously reflects features of the regional structure, but far too little is known about the complex details of the regional structure to permit the formulation of reasonably acceptable explanations of its control on the emplacement of individual ultramafic masses. Many masses appear to have been intruded along contacts between units of the older rocks and therefore lie roughly parallel to the strike of these rocks. It is not clear, however, whether the masses are truly sill-like or whether they occupy fault zones that transect dips of the formations [in section]. Ferguson (32), among others, has suggested that the masses of the "great serpentine belt" were intruded along a major zone of reverse faults and that this zone may represent the northward extension of the Mother Lode fault zone. This hypothesis seems entirely reasonable to the writer, for all the ultramafic masses of the belt lie near, but west of, the western boundary of the Blue Canyon formation, which is in fault contact with younger(?) formations, at least from Downieville southward almost to the Bear River. The numerous ultramafic masses west of the main belt, as well as those along and east of the eastern margin of the Blue Canyon formation, may occupy subordinate fault zones that also parallel the strike of the regional structure.

CHARACTERISTICS AND OCCURRENCE OF CHROMITE

Composition of Chromite

Chromite is the only one of many chromium-bearing minerals that occurs in sufficient quantity to provide a commercial source of chromium. Furthermore, the mineral itself has special chemical and physical properties that make it valuable as a refractory material. Most chromite has

* Taliaferro's generalized section along Cosumnes River is reproduced as fig. 2 in the report entitled "Chromite deposits of El Dorado County, California," which constitutes chapter 4 of part III of this bulletin.

Table 2. Partial analyses of massive chromite ores from deposits in the northern Sierra Nevada, California

Sample*	A	B	C	D	E	F	G	H
Cr_2O_3	40.60	39.41	43.20	41.97	40.59	50.30	54.73	54.60
Fe	11.76	11.29	9.88	11.81	12.01	10.09	11.95	12.50
SiO_2	0.22	9.25	5.33	6.80	9.80	6.84	3.99	4.39
Al_2O_3	—	14.43	20.63	20.23	16.41	10.31	—	—
MgO	—	18.09	14.60	12.96	15.43	16.36	—	—
CaO	—	—	0.05	—	—	—	—	—
P	0.10	—	—	0.08	0.04	0.04	—	—
S	—	—	—	0.16	0.02	0.03	—	—
Cr/Fe	2.36	2.39	2.99	2.43	2.31	3.41	3.13	2.99

* Samples are arranged according to increasing Cr_2O_3 content estimated for pure chromite in samples.
A. Milton claim, Sierra County. Specimen analysed by Smith Emery & Co.
B. Little Hope claim, Butte County. Metals Reserve Co. sample of 12-ton lot.
C. Lambert mine, Butte County. 200-pound sample analysed by the Kaiser Co.
D. Spot claim, Plumas County. Metals Reserve Co. sample of 34-ton lot.
E. Commander claim, Plumas County. Metals Reserve Co. sample of 14-ton lot.
F. White Pine mine, Plumas County. Average of Metals Reserve Co. samples of three lots aggregating 174 tons.
G. Christian Place, Butte County. Metals Reserve Co. sample of 18-ton lot.
H. Sunset mine, Placer County. Average of Metals Reserve Co. samples of seven lots aggregating 182 tons.

an iron-black color and a submetallic to almost vitreous luster, but chromite that has been sheared or crushed has a brownish-black to chocolate-brown color and has a dull luster if finely crushed. It has a specific gravity between 4 and 5 and a hardness of about 5.5; it can be scratched readily with a knife. Some chromite is slightly magnetic, but a chocolate-brown streak distinguishes it from magnetite.

Chromite is a member of the spinel group of minerals and crystallizes in the isometric system. Stevens (44) has shown chromite to be an isomorphic compound of the six end members magnesiochromite ($MgO.Cr_2O_3$), ferrochromite ($FeO.Cr_2O_3$), spinel ($MgO.Al_2O_3$), hercynite ($FeO.Al_2O_3$), magnesioferrite ($MgO.Fe_2O_3$), and magnetite ($FeO.Fe_2O_3$). Chromite from different deposits therefore may have widely different compositions owing to different combinations and proportions of the end members. Even in an individual deposit the chromite may vary in composition, but probably within a rather restricted range. The pure mineral may contain less than 30 percent to more than 60 percent Cr_2O_3. No analyses are available for pure chromite from deposits in the northern Sierra Nevada, but the ore analyses given in table 2 indicate, in a general way, the compositional variation of the chromite found in the region.

Other Chromium Minerals

Several economically insignificant but scientifically interesting chromium-bearing minerals occur in small amounts with the chromite in many of the deposits in the northern Sierra Nevada; one and possibly two others occur in the ultramafic rocks but apparently are not associated with the chromite. Perhaps the most common of these is uvarovite, the emerald-green chromium-bearing garnet, which usually occurs as vein-

lets, drusy incrustations, or bright green smears in or on the chromite. At one deposit in Placer County the occurrence of uvarovite is unique in that the garnet constitutes about half the matrix of an ore consisting of approximately equal parts of gangue minerals and disseminated chromite. Another common mineral in the deposits is kammererite, the purple to pink chromium-bearing chlorite, which also occurs as veinlets and smears with the chromite. A similar mineral, kotschubeite, rose-red in color, has been identified in ore from a deposit on the North Fork of the American River (Melville and Lindgren 90), and some of the kammererite reported at other localities might well be kotschubeite instead. The lilac-colored micaceous carbonate, stichtite, has not yet been reported in this region.

Chromrutile, a new mineral found only at the Red Ledge mine in Nevada County, has been described by Gordon and Shannon (28). It contains 16.61 percent Cr_2O_3 and 69.71 percent TiO_2 and occurs as minute brilliant black prismatic crystals with kammererite on massive chromite.

Mariposite, the apple-green chromium-bearing mica, occurs in the quartz veins and adjoining serpentine in the Alleghany district of Sierra County. This mineral has not been reported in any of the chromite deposits, but its chromium content presumably is derived from chromite in the ultramafic rocks. The chromium in the bright-green pyroxene, chrome diopside, may have a similar origin; chrome diopside has not been reported in the region, however.

Unlike chromite, the minerals described above apparently have a hydrothermal origin, and, with the exception of mariposite and chrome diopside, are intimately associated with concentrations of chromite. Their presence or absence, however, has no significance as an indication of the amount or tenor of ore in a deposit. It should be noted here that serpentine and other alteration minerals found in bodies of ultramafic rocks sometimes have a peculiar greenish or purplish coloration not due to the presence of chromium. Not a few prospectors have supposed these so-called "chrome stains" to indicate the proximity of an ore body. This concept is entirely erroneous and should not be relied on as a guide for prospecting.

Uses and Specifications. Chromite is used mainly in the manufacture of metallurgical, refractory, and chemical products. The amount of chromite consumed by domestic industry for these products varies from year to year. According to Minerals Yearbook for 1949, the consumption that year totaled 511,404 long tons of ore, of which 47 percent was used for metallurgical products, 40 percent for refractories, and 17 percent for chemicals. Most of the metallurgical chromite is converted to ferrochromium, which is used in making special steels such as stainless, structural, tool, high-speed, bearing, and armor steels. By a patented process, raw chromite may be added to the melt in an electric steel furnace, thus eliminating the usual conversion to ferrochromium. Chromite refractories are resistant to both basic and acidic slags and are used in brick and cement form to line furnaces. Chromite used to make chemical products usually is converted to sodium bichromate, which then is used as the source of chromium for various plating purposes, for pigments (red, orange, yellow, and green shades), for tanning compounds, and for various other chemicals.

The specifications for chromite ores vary with the use and also with the supply and demand. Requirements for ore to be used in making ferrochromium are: a Cr_2O_3 content of at least 48 percent, a Cr to Fe ratio of not less than 3 to 1, a low silica content, and a combined alumina and magnesia content not exceeding 25 percent. Hard, lumpy ore is preferred. The specifications are not so high for ore that is to be added directly to steel furnaces; such ore may contain less than 45 percent Cr_2O_3 and the Cr to Fe ratio may be quite low.

Refractory chromite should have a combined Cr_2O_3 and Al_2O_3 content between 57 and 63 percent, and not more than 10 percent Fe and 5 percent SiO_2. Hard lump ore that can be ground to the manufacturer's specifications is preferred for making refractory bricks, but fines and concentrates are suitable for making refractory cements.

Chemical-grade chromite should contain at least 45 percent Cr_2O_3 and not more than 5 percent SiO_2. Ore with a relatively high iron content may be used and even may be preferred because it decomposes more readily. Fines or concentrates also are easier to disintegrate. Sulphur in excess of 0.50 percent and phosphorus in excess of 0.20 percent make ore undesirable for all uses, but most ores contain less than these amounts.

The specifications outlined above are those for a normal market and current industrial practices and preferences. Under conditions of short supply or increased wartime demand, chromite of lower grade can be used for most metallurgical and chemical purposes without seriously affecting the quality of the final product. Although high-chromium ores are demanded at present, the more abundant high-iron ores should become more and more acceptable as industrial techniques are improved.

Ore Bodies

Chromite deposits in the northern Sierra Nevada may be grouped into two categories—primary deposits and detrital deposits. Primary deposits are those that occur embedded in the original host rocks, whereas detrital deposits are those that have been more or less disengaged from the host rocks by weathering and other erosional processes. Included in the detrital category are deposits in residual soil or saprolite, deposits of float, and placer deposits. In some areas detrital deposits have contributed a large share of the chromite produced, but in the region as a whole the primary deposits are more numerous and are the most productive.

Primary Deposits

Two distinct but intergradational types of ore are found in the primary deposits. Ore consisting of chromite grains more or less dispersed in the host rock is called disseminated ore, whereas that consisting of a dense aggregate of chromite grains is called massive ore. A subordinate type consists of nodular accumulations of chromite, but usually is considered as one or the other of the main types, depending on the relative concentration of the nodules. Although the two main types of ore grade into one another, ore bodies consisting mainly of disseminated ore have characteristics that differ somewhat from those of bodies consisting mainly of massive ore.

Disseminated Ore. Disseminated ore consists of chromite grains scattered at random or accumulated into small clots, clusters, schlieren, stringers, or layers in dunite. It may contain from 10 to 75 percent

chromite, grading into massive ore on the one hand and rock containing only accessory chromite on the other. The individual as well as the aggregate accumulations of chromite in bodies of disseminated ore commonly grade sharply outward into leaner ore or barren dunite. Individual chromite grains in the ore range from 0.1 to 5.0 mm in diameter, but usually average between 0.5 and 1.0 mm. In general, the evenly disseminated grains are quite uniform in size, and the chromite in the richest accumulations is coarsest. Most bodies of disseminated ore have a lenticular or tabular form, but some are highly irregular. Streaks, schlieren, pencil-like aggregates, and other linear elements exhibited by the ore commonly indicate the elongate direction of an ore body, and both linear and planar elements are parallel to corresponding structures in the enclosing dunite and peridotite.

Massive Ore. Massive ore differs from disseminated ore in that it consists largely of chromite with little or no interstitial silicates. Bodies of massive ore, however, may include irregular masses of disseminated ore or may have disseminated ore on their margins. The chromite grains in the typical massive ore are rather coarse, ranging from 1 mm to 1 cm in diameter, but some massive ore is so fine-grained that it appears almost aphanitic. Bodies of massive ore are so variable in form that one is often hard-pressed to find a suitable term to describe their shape. The terms lens, pod, kidney, chimney, knocker, and stringer have been used widely. These and other terms evidently do not represent the same shapes to the minds of everyone, for different writers have used different terms to describe identical ore bodies. This writer prefers to use lens for an ore body that is roughly tabular with tapering edges, pod for one that is indefinite in shape but bounded by irregular and rounded surfaces, and stringer for elongate bodies with irregular and ragged edges. Notwithstanding, in this report the original terms of other writers are retained in descriptions based solely on their observations.

Size and Grade. In California, deposits of massive ore range from only a few pounds to almost 20,000 tons, and deposits of disseminated ore range from a few pounds to more than 300,000 tons. The total amount of contained chromite in each of the two deposits is approximately the same. The largest individual body of massive ore yet found in the northern Sierra Nevada may contain as much as 2,500 long tons of ore, but, as a rule, the deposits in the region are rather small and most contain less than 100 long tons of ore. The largest deposit of disseminated ore known in the region may hold about 20,000 long tons of ore (equivalent to approximately 6,000 long tons of chromite), but most contain only a few hundred tons of ore.

Table 3 shows the number and distribution of deposits in various size groups. The figures represent deposits, not individual ore bodies, and only those deposits whose ore contains more than 30 percent Cr_2O_3 are included. Inasmuch as the ultramafic rocks constituting the "great serpentine belt" are essentially part of one intrusion, the deposits in the belt are listed in separate columns headed by the Roman numeral I, whereas those in all other masses are combined and listed in columns headed by the Roman numeral II.

The principal production of chromite from deposits in the northern Sierra Nevada, or, for that matter, from most deposits in California,

Table 3. Numerical and percentage distribution, by location and tonnage range, of chromite deposits in the northern Sierra Nevada, California

Range in long tons	Placer		Nevada		Sierra		Yuba	Butte	Plumas		Total number of deposits		Percentage of grand total
	I	II	I	II	I	II	II	II	I	II	I	II	
0-50	32	3	7	15	12	1	2	20	29	1	80	42	58
50-100	17	1	4	1	3	1	—	10	5	—	29	13	20
100-500	20	—	1	3	3	2	—	3	—	1	24	9	15-16
500-1,000	2	—	—	3	—	—	—	2	1	—	3	5	4
More than 1,000	2	—	1	—	—	—	—	2	—	—	3	2	2-3
Total number of deposits	73	4	13	22	18	4	2	37	35	2	139	71	
											210 (Grand total)		
Percentage of grand total	36-37		16-17		10-11		1	17-18	17-18				

I. Deposits in "great serpentine belt."
II. Deposits in other ultramafic masses.

has been during periods when ore was salable if it contained as little as 30 or 35 percent Cr_2O_3. For this reason, mainly, crude ore that contains 30 percent or more of Cr_2O_3 is considered to be shipping-grade ore for the purposes of this report, and that containing less than 30 percent Cr_2O_3 is considered to be milling-grade or concentrating ore. The grade of a chromite ore depends not only on the amount of chromite in the ore but also on the composition of the chromite itself. In general, the chromite in the deposits of the region is a fair to good quality (see table 2), and practically all the massive ores and some of the richer disseminated ores contain more than 35 percent Cr_2O_3. Furthermore, some lower-grade disseminated ores contain richer portions that can be sorted out as shipping-grade ore. Most of the disseminated ores require concentration, however.

Table 4 shows the number and distribution of deposits that have yielded shipping-grade ore. Although information on grade is not available for all deposits in the region, the data shown probably are representative for the region as a whole. At least 25 deposits have yielded ore containing more than 50 percent Cr_2O_3; the ore from one deposit in Nevada County reportedly contained 62 percent Cr_2O_3. All but one of the deposits that have yielded ore containing more than 50 percent Cr_2O_3 and most of those that have yielded ore containing more than 45 percent Cr_2O_3 occur in the "great serpentine belt." On the other hand, most of the deposits of disseminated ore of milling grade occur in the westernmost ultramafic masses.

Of the lots of ore purchased by the Metals Reserve Co. during 1942-45, all those containing more than 50 percent Cr_2O_3 had Cr to Fe ratios of 2.5 or higher, and nearly all those containing less than 40 percent Cr_2O_3 had Cr to Fe ratios below 2.5.

Table 4. Numerical and percentage distribution, by tenor range and location, of chromite deposits in the northern Sierra Nevada, California

County	Percent Cr_2O_3				Number of deposits	
	30-45		45-62		Known tenor	Unknown tenor
	I	II	I	II		
Placer	16	3	38	—	57	19
Nevada	5	16	5	—	26	6
Sierra	5	2	8	—	15	12
Yuba	—	1	—	—	1	—
Butte	—	25	—	6	31	8
Plumas	15	2	8	—	25	12
Totals	41	49	59	4	153	57
Percentage of total deposits of known tenor	27	32	38.5	3.6		
	59		41			

I. Deposits in "great serpentine belt."
II. Deposits in other ultramafic masses.

At this point it should be pointed out that a satisfactory concentrate cannot be made from all disseminated ores; for the chromite in some, usually those ores that have a very low percentage of chromite or those that are very fine grained, apparently has a high iron content that cannot be eliminated by the usual methods of concentration. For example, concentrate made from the low-grade, fine-grained ore of one deposit in Placer County contained 43.93 percent Cr_2O_3 and 19.70 percent Fe with a Cr to Fe ratio of only 1.53. A sample of ore from the largest known deposit of disseminated ore in the region (one in Butte County) assayed 29.81 percent Cr_2O_3 and 11.66 percent Fe before concentration; and the panned concentrate assayed 42.45 percent Cr_2O_3 and 15.50 percent Fe, with a Cr to Fe ratio of only 1.88. These examples are given to illustrate the importance of determining the compositional character of the pure chromite in an ore being considered for concentration before proceeding far with plans to erect a concentrating plant.

Localization. Although many chromite deposits in California have been studied in detail, few clues pertaining to their localization have been recognized. It is known that primary deposits are found only in ultramafic rocks, almost always in the variety called dunite. However, a mass of ultramafic rocks may include many or only one or no dunite bodies; if present, the dunite bodies may be either large or small, and may contain many or only one or no ore bodies. Furthermore, dunite bodies may occur anywhere in an ultramafic mass and ore bodies may occur anywhere in a dunite body. Dunite and ore bodies undoubtedly occur at depth as well as near the surface in many ultramafic masses, but few, if any, deeply buried ore bodies are likely to be found. Drilling for them seldom can be justified, and no geophysical method for locating them has been devised as yet. It follows, therefore, that only those ore bodies that occur at or near the surface are of real economic significance, but even the locations of these cannot be predicted unless the presence of ore is evidenced by float, outcrop, or an old working that has yielded ore.

Several criteria are recognized that generally prove reliable as guides in the search for virgin ore bodies whose presence and approximate location are indicated by float, outcrop, or old workings. Inasmuch as the ore bodies normally occur only in dunite or serpentine derived from dunite, exploration in other varieties of ultramafic rocks is not apt to be fruitful and should be avoided if possible. Some ore bodies, however, have only a thin border of dunite and may appear to be in another variety of rock if this border is sheared or altered beyond recognition.

Many ore bodies or groups of ore bodies, especially those composed of massive ore, are associated with fractures, faults, or shear zones. This association is an important feature of the deposits, but it must be realized that the fracturing or shearing occurred *after* the ore bodies were formed, not before, as many chromite miners and prospectors assume. Shear zones tend to develop along zones of weakness in an ultramafic mass. An ore body or group of ore bodies, being more incompetent than the surrounding rocks, constitutes an inherent zone of weakness, and shearing stresses commonly are localized along such a zone. All shear zones in ultramafic rocks do not contain ore, however, for most of them are developed along other elements of incompetence. When ore has been found in a well-defined fault or shear zone, the search for associated ore

bodies should be focused on that particular fault or shear zone rather than on all faults or shear zones in the vicinity.

A chromite deposit frequently consists of a series of two or more ore bodies with their long axes in approximate alignment. This alignment probably is due to rotation of the long axes to the direction of least resistance, by primary flowage, by later shearing, or by both kinds of movements. The ore bodies in a group commonly are connected by narrow stringers of chromite or by narrow zones of sheared or comminuted chromite. If present, these "leads" usually are reliable guides to adjoining ore bodies, but they also may lead to nothing but barren sheared rock if there is a large angular discordance between the direction of elongation of the ore zone and the principal direction of shear. In most deposits exploration should follow the direction that is pointed out by the long axes of known ore bodies.

It is seldom possible to determine merely by inspection whether a known ore body is the sole constituent of the original deposit or whether it is the first, the last, or an intermediate representative of a group of ore bodies. The ore bodies of a group may lie within a few feet of each other or they may be more than 100 feet apart. The extent to which any deposit should be explored depends partly on the geologic and economic characteristics of that deposit and partly on the means of an interested operator and the risk he is willing to take. Each case must be considered on its own merits. Careful consideration of the criteria given above may help operators to exploit deposits more efficiently than heretofore.

Detrital Deposits

Though small and relatively few, detrital deposits of chromite exhibit special features deemed worthy of separate description. All the detrital deposits owe their origin to the primary deposits and, indeed, most primary deposits are discovered as the result of tracing detrital chromite to its source. As noted previously, detrital deposits are of three types—residual, float, and placer—each type in that order representing a greater degree of transport from the parent deposit.

Residual deposits are the result of in-place weathering and decomposition of the rocks enclosing a primary deposit at or near the surface. The host rock is decomposed into clay and soil and the resistant chromite thus acquires a new habitat with little or no change in position. Residual ore bodies, especially those composed of massive ore, may retain their original shape for a time, but those that are broken by fractures or cut by seams of dunite or serpentine eventually break up into angular or subangular blocks, and those that contain much interstitial silicate material disintegrate into friable masses of chromite grains.

Slow erosional processes, such as soil-creep, frost action, and landsliding, tend to disperse the chromite fragments and may displace the entire deposit some distance from its original position. Hydraulic erosion, however, removes the clay and soil at a faster rate than the heavy chromite and leaves the chromite exposed as float. Float deposits also may be derived directly from primary deposits if mechanical erosion predominates over chemical erosion. Thus, an ore body that is partly or wholly exposed by erosion disintegrates into fragments of float, which may be found scattered near, or considerably distant from, the site of the original outcrop. Pieces of float ore weighing as much as 20 or 25 long tons have been found, but most pieces are much smaller, ranging in

*Table 5. Mineral composition of black sands from placer deposits in the northern Sierra Nevada, California * (in pounds per long ton)*

Locality	Chromite	Magnetite	Ilmenite	Hematite	Zircon	Garnet	Miscellaneous	Remarks
Butte County:								
Magalia	222	1,330		342	trace		104	Drift mining.
Oroville	250	1,400	150	150			50	Dredge cleanup.
Nevada County:								
Rough and Ready	833	492			14	446	215	
Do	200	500	800	200	50		250	Hydraulic cleanup.
Placer County:								
Michigan Bluff	352	1,528					120	3 lb/ton gravel.
North Fork American River	160	850		300	340		350	50 lb/ton gravel.
Plumas County:								
La Porte	340	1,151	384				125	Sluice box concentrate.
Rock Island Hill	496	888			88		528	
Yuba County:								
Camptonville	1,800	25			40		135	1 lb/3 yards of gravel.
Yuba River	150	520	280				1,150	4 lb/ton gravel.

* Data from Day, D. T., and Richards, R. H., Mineral Resources U. S. 1905, pp. 1182-1190, 1906.

weight from a few ounces to a few hundred pounds. The pieces of float are generally too widely dispersed to be of economic value.

Placer chromite deposits are the result of fluvial reconcentration of the chromite content of eroded ultramafic rocks and include the accessory chromite grains as well as the chromite eroded from primary, residual, and float deposits. Placer deposits ordinarily are far removed from the original sources of the chromite, and the history of concentration may be long and complicated. Placer chromite has two principal modes of occurrence, one in the black sands along the courses of rivers and streams draining areas of ultramafic rocks, and the other in the black sands of marine beach deposits. The black-sand accumulations along rivers and streams seldom are large enough to be worked for their chromite content, but some beach deposits, like those along the southern part of the coast of Oregon (see Griggs 45), are quite extensive and have been exploited successfully. In addition to chromite, the black sands of both rivers and beaches contain other heavy minerals, including magnetite, ilmenite, hematite, zircon, garnet, olivine, pyroxene, gold, and platinum. The mineral composition of 10 samples of black sand from the northern Sierra Nevada is shown in table 5.

Chromite has long been known to occur in the auriferous black sands along the westward-flowing rivers of the northern Sierra Nevada, but the amount of chromiferous black sand concentrated in any one place is so small that no one has attempted to recover the chromite on a commercial scale. On the other hand, residual and float deposits have contributed an appreciable amount of the chromite produced in some parts of the region. Float ore has been recovered in small amounts in the vicinity of numerous primary deposits exposed by the vigorous erosional processes operating during Recent time, but the most notable of the detrital deposits owe their formation and preservation to a combination of conditions that have prevailed since early Tertiary time. The Sierra Nevada was reduced to a surface of comparatively low relief by the long period of erosion following the Nevadan orogeny. Float from primary deposits exposed during the later part of this cycle tended to remain close to its source. Furthermore, deep weathering of the early Tertiary land surface produced residual deposits in the thick mantle of soil developed on some areas of ultramafic rocks, and, because of the low relief, this soil mantle was not entirely washed away; a part of it was buried by the Tertiary volcanic rocks. Many detrital deposits thus formed were destroyed by Tertiary and Recent streams as they cut through the protective cover of volcanic rocks into the rocks underlying the old land surface; nevertheless, some deposits still remain beneath the volcanic rocks capping the present ridge tops, and at least two of these have been discovered in the course of mining for placer gold in the buried Tertiary gravels. Parts of others, such as those on the Forest Hill Divide in Placer County, were preserved even after the volcanic cover was removed because of favorable locations in wide upland areas where Recent erosion has been somewhat retarded.

RESERVES

The known or measured reserves of chromite in the northern Sierra Nevada are small, and neither indicated nor inferred reserves can be estimated with any degree of accuracy. Shipping-grade ore is exposed

at very few deposits, though some is reported to remain in the old workings of some deposits. At best, one can only speculate on the possibility that any particular deposit contains more than a few tons of shipping-grade ore until the ore actually is blocked out or mined. Nevertheless, the potential reserves of the region should be at least equal in amount to the past production, or approximately 32,000 long tons of ore. Actual production of this amount of ore, however, probably would require considerable economic pressure.

Most exposed areas of ultramafic rocks have been prospected quite thoroughly, but further prospecting undoubtedly will be rewarded with the discovery of some new ore bodies. The deposits of the region are characteristically small and offer little hope that many containing more than 1,000 long tons of shipping-grade ore will be found; most deposits probably will contain considerably less than 500 long tons of shipping-grade ore.

A few deposits of milling-grade ore might be counted on to supply a relatively large quantity of chromite should the need for high-iron chromite be great enough to warrant their exploitation. The largest of these deposits might yield as much as 5,000 or 6,000 long tons of concentrates and two or three others each might yield several hundred tons of concentrates. Additional attempts to concentrate the chromite in the residual soils likely would prove unsuccessful, as in the past, because of the difficulty of removing the iron oxides from the concentrates. The dumps of many old deposits constitute a potential source of perhaps several thousand tons of chromite. Some of these dumps contain appreciable amounts of fragmental chromite that might be recovered on jigs. The dumps are widely scattered and the average dump would yield but a few tons of chromite. Nevertheless, the recovery of the chromite from many dumps might be feasible with a simple portable concentrator.

Although most of the known deposits of shipping-grade ore appear to be mined out because no ore shows in the workings, the writer firmly believes that many of them still contain undiscovered ore bodies and that the greater part of any future production will stem from further exploitation of the known deposits. He would be hard-pressed, however, to furnish valid recommendations as to which of these deposits might contain more ore. Almost any one of them might be a good prospect, but the fact is that only actual exploration can determine which are good and which are poor. It is hoped that some of the information in this report will prove useful to operators who may undertake further exploration of the deposits.

The reopening of an old deposit, or the opening of a virgin deposit, involves considerable risk with little or no guarantee that sufficient ore will be found to repay the operator's investment. Consequently, any important future production from deposits in the region probably will require ample economic stimuli to make the operator's risk appear less formidable than it does now. Under any circumstances, the amount of ore that ultimately can be produced from the deposits will be mainly of local consequence and can have but little significance as far as national requirements are concerned.

DESCRIPTION OF DEPOSITS BY COUNTIES

The following pages are devoted mainly to detailed descriptions of the chromite mining activities and deposits in each of the counties of the northern Sierra Nevada. The counties are taken up in a south to north sequence and the deposits within each county are considered geographically by areas bearing the name or names of well-known local features. Deposits whose locations are shown on plates 13 and 14 are numbered in approximate order from north to south and, except for a few convenient deviations, are described in numerical order. Furthermore, deposits that are identified by number on the Economic Mineral Map of California * are indicated by the corresponding number in brackets.

Many of the deposits have been known by more than one name, but these are described here under the most recent name known unless an older name has local preference because of long-continued common usage. If the old and new names of a deposit or a group of deposits cannot be correlated definitely, a separate description is given under each name. Tabulated and cross-referenced lists of all reported names of the deposits are given at the end of this report.

Placer County

Introduction

Placer County comprises an irregular elongate area of 1,431 square miles that spans the Sierra Nevada between the Bear River on the north and the Middle Fork of the American River and the Rubicon River on the south (see pl. 12). The western part of the county, including a strip of the Great Valley about 10 miles wide and a strip of foothills about 15 miles wide, embraces the larger communities and industries and supports the greater part of the population, which the 1950 census shows as 41,266. The central part of the county is a region of forested ridges separated by deep canyons, whose inhabitants are employed mainly in mining and lumbering. The eastern part is a sparsely settled region of high peaks, lakes, and mountain valleys, noted as a resort and recreational area.

All the chromite deposits occur in three roughly parallel belts of ultramafic rocks that trend northward across the central part of the county, and all but about a dozen of the known deposits are in the large, steeply dipping ultramafic mass that constitutes the easternmost belt, called the "great serpentine belt." This mass lies along the western margin of the Blue Canyon formation, possibly in a fault zone, but is separated from other formations corresponding to the Calaveras formation to the west by masses of gabbro and schistose amphibolitic rocks. From the Middle Fork of the American River northward across the Forest Hill Divide to the North Fork of the American River, the "great serpentine belt" apparently is represented by a single continuous body of ultramafic rocks; but this body is split along the strike into several segments in the Dutch Flat area between the North Fork of the American River and the Bear River.

The central belt includes several ultramafic masses intruded in or along the borders of a band of Mariposa slate about 3 miles wide that trends

* Outline geologic map of California, showing locations of chromite properties: California Div. Mines, Economic mineral map of California, No. 3—Chromite, 1942.

north-northwestward across the county from the Gas Canyon area through the Colfax-New England Mills area and into Nevada County. Although 9 or 10 chromite deposits have been found in these masses, all are small and the ore is of low grade.

The western belt comprises a series of highly sheared serpentine masses intruded into diabase and amphibolite schist east of the Auburn-Grass Valley highway. Only two chromite deposits, one of disseminated ore and one of massive ore, have been found in this belt; both are in the serpentine between the north and south forks of Dry Creek.

History and Production

Placer County ranks ninth among the chromite-producing counties of California and first among the counties of the northern Sierra Nevada by virtue of a total production of approximately 15,645 long tons of ore. Of more than 120 deposits that have been reported, only two have yielded as much as 1,000 long tons of ore and only four others have yielded more than 500 long tons. More than two-thirds of the deposits have yielded less than 100 long tons of ore, and some of these contributed only a few tons each. Detailed production figures for deposits in the county are shown in table 6.

The earliest recorded chromite production in Placer County was during the early eighties. Approximately 2,000 long tons of the 4,900 long tons of ore credited to the county for this period, however, probably came from El Dorado County. The early production apparently was induced by demands for refractory material to line the furnaces of an iron smelter located near Hotaling on the north fork of Dry Creek. The deposit on the south fork of Dry Creek probably supplied a little ore to the smelter, and one or two deposits in the Dutch Flat area may have contributed also. According to "old timers," however, the early chromite mining activities were restricted mainly to deposits in the vicinity of Michigan Bluff and deposits in an area northeast of Forest Hill called Brimstone Plains in those days. Much of the ore taken from the latter area consisted of float that is said to have been scattered about the area in relative abundance. The ore was collected in two stockpiles near the main wagon roads in each area and was picked up in small lots by empty wagons returning to Colfax or Auburn for supplies. A little of the stockpiled ore was shipped as late as 1890, but production practically ceased when the smelter closed down in the middle eighties.

The deposits lay idle until 1916, when the market for chromite was stimulated by wartime demands. Most of the deposits now known were found and exploited during World War I, and more than two-thirds of the total production credited to the county was shipped during the period 1916-19. Float, residual, and primary deposits were worked and two concentrating plants were operated. One plant in the Forest Hill Divide area recovered chromite from residual soil and from discarded fines in dumps around several deposits. Another plant with a capacity of 50 tons per day concentrated disseminated ore from a deposit in the Dry Creek area.

Unlike most chromite-producing counties in California, Placer County continued to supply chromite in small amounts during many of the years between World Wars I and II. A few shipments, notably those made in 1919 and 1920, consisted of ore stocks left over after the Armistice, but most of the subsequent shipments were made by one operator from several deposits of high-grade ore in the Dutch Flat area.

The establishment of a purchasing depot and stockpile at Auburn by the U. S. Vanadium Corp. in 1941, together with an increase in the market price of chromite, stimulated numerous operators to revive production. Early in 1942 the Metals Reserve Co. began to purchase ore at its Sacramento stockpile and later in the same year it established a more convenient purchasing depot at Auburn, with stockpiling facilities at nearby Bowman. Production in 1942, however, fell short of that in 1941 and continued to fall off during 1943, 1944, and 1945. No ore has been shipped from the county since 1945.

With the exception of a little desultory prospecting in the central belt and an unsuccessful attempt to produce acceptable concentrates from low-grade disseminated ore in a deposit in the western belt, chromite mining in Placer County during World War II was confined to the Dutch Flat and Forest Hill Divide areas in the "great serpentine belt." As during the two previous periods of notable production, an appreciable amount of the ore mined in the Forest Hill Divide area during 1941-45 was detrital ore from float and residual deposits. Such deposits have been searched out and worked thoroughly by now and are not likely to contribute much ore to future operators. In 1942 interest was aroused concerning the possibilities of recovering chromite from low-grade concentrations in the residual clay and soil on the upland surface of the Forest Hill Divide. Three washing plants operated on such material for a short time and produced some high-iron concentrates from the richest material found, but plans to treat the very low-grade material were abandoned because no simple way could be devised for removing the deleterious iron oxide from the concentrate.

The outlook for future production in the county would seem to depend largely on what success may be attained by further exploration of known primary deposits. Several of these in the Forest Hill Divide area are considered to be quite promising, but many others in the eastern belt also may hold additional ore of a good quality. The most promising area to prospect for virgin deposits is that section of the eastern belt that crosses the steep canyon of the North Fork of the American River. This section may not have been prospected thoroughly in the past, owing to its relative inaccessibility.

Mines and Prospects

Dutch Flat Area

Bear River Chrome Mine (1, 2)

The Bear River Chrome mine has been referred to also as the Sullivan Chrome mine and as the Sullivan-Hemphill-Nobel mine. The first mining was done by a man known as Cap Gallatin, who mined an immense boulder of ore in the early eighties. D. J. Sullivan, W. F. Hemphill, and R. E. Nobel operated the mine during the period 1917-22. The property comprised the $N\frac{1}{2}NE\frac{1}{4}$ and the $NE\frac{1}{4}NW\frac{1}{4}$ sec. 19, T. 16 N., R. 11 E., leased from the Central Pacific Railroad Co., and one located claim adjoining in sec. 18. In 1949 the Pacific Gas & Electric Co. owned the $NW\frac{1}{4}$ and Clarence Klug of Los Angeles owned the $N\frac{1}{2}NE\frac{1}{4}$ of sec. 19. Jack H. Hancock located the Black Nugget claim during World War II on the east side of Bear River near the line between secs. 18 and 19, and this claim may include part of the old Bear River Chrome property. The principal workings made during World War I were located near the

Table 6. Chromite production from Placer County, California (in long tons)

Property or shipper (S)	Map number	Pre-1916	1916	1917	1918	1919	Pre-1920 unofficial estimate*	1920-40		1941	1942	1943	1944	1945-49		Total	Total unofficial estimate*
								Year	Tons					Year	Tons		
Alta Spaulding					6	[c]16	22									22	22
Anderson Hill												10				10	10
Bear River Chrome	1, 2	[1]		100	[a]53	42	250	1920	[a]36							231	300
Beat	5				[b]30		35	1920	[a]14								
								1921	68								
								1922	117								
								1923	45								
								1925	22								
								1933	38								
								1935	13	39				1945	15	401	500
Bee Bee and Blue Bell	38c, 38d				[4]		50±			35						35	85±
Bell					[2]		?										?
Bessie B	40				[4]		50±						[a]40	1945	[a]3	43	95±
Black Arrow Ranch	90	[1]			[2]		150										150
Black Rock Chrome	79			[2]	[2]		105										105
Black Sheep				[4]	[4]		100+	1920	[d](89)								100+
Blue Jay					[4]		50±					[a]15				15	65±
Bobo										5	11					16	16
Boiler Pit	41		[3]	[3]			1,000±			[7]							1,015±
Bugg	82		[b]67				67									67	67
Bunker	67, 68	[1]		[b]570	132	[d](25)	1,500±				[a]36	93				831	1,630±
Buttercup Chrome	72				[a]150		150									150	150
Buzzard	34a, 34b				[4]		50±				11	69				80	130±
Capp's Pit	51										[7]						20
Chucho	35a, 35b									2	[a]2					4	4
Chrome						[c]38	38									38	38
Chromite	75				[2]		?										?
Clinton Burro	75				58	[c]4	62	1920	[d](27)							62	62
Coal Pit	69	?		?	?		?										?
Crittenden's Capco lease										51						51	51
Daisy Bell	39			[4]	[4]		600±						[a]25	1945	[a]18	43	650±
Dart and Braden's Capco lease	54a?			[3]	[3]		[5]				[a]49					49	[5]
Dunbar lease	8									[2]	[7]						3
Dunn's Capco lease										140						140	140
Dusty Queen												[a]2				2	2

Erskine					13		13										13	13
Esther and Phyllis	20									137	[a]11	[a]22				170	170
Fagg						[c]3	3									3	3
Farmer	84-88				50	[d](179)	50									50	50
Fiddler's Green	88			2			5										5
Finning property	60, 61				2	[d](36)	50	1920	[d](45)	7							50
Garrison, G. H. (S)					111	[d](89)	6	1920	[d](85)							111	6
Gas Canyon	86			2	2		40										40
Gore					2		?										?
Green (Americus)	85			2			10										10
Green's CAPCO leases	48													1945	[a]26	26	26
	49?												[a]26			26	26
	52												[a]78			78	78
	53a?												[a]24			24	24
	54[a]			3	3		100±					20	[a]77			97	300±
Hayes Chrome	58				2		?										?
Hazel					2		10										10
Hewes and Jones (S)					69	[c]85	6									154	6
High-grade Pit	45										7						130
Hodge Ranch	4		163	80	41		250	1920	2							284	250
Horseshoe	30									[a]12	[a]63					75	75
Iowa Hill Chrome	24, 25			201	96	[c]29	325									326	325
Iron Spring	9				2		6										6
Julian	7				2		1										1
Kidder Pit	56				4		70										70
King					2		?										?
Knudsen, R. N. (S)										[e]242	[f]249					491	1
Lightning Streak No. 1	37a, 37b				4		5+						[a]3			3	10+
Lightning Streak No. 2	33b, 33c,																
	33e				4	[c]52	50+				[a]9	[a]16		1945	8	85	85+
Little Greek	77				2		50										50
Little V													10			10	10
Long Pit	49										7						30
Lookout					2		?										?
Lucky Hunter	22									17						17	17
Lucky Strike	12				2		15										15
Lucky Strike	80										20					20	20
Mgralls' CAPCO leases	53a												[a]44			44	44
	53b												[a]72			72	72
	54a			3	3		5							1945	[a]53	53	5
Mastel's CAPCO lease												[a]9				9	9
McCoy					86	[c]22	120									108	120
Meyer property			8				8									8	8
Mountain View group	70				2	[d](18)	60	1920	[d](13)	[a]62		9				71	131
Mystery	78?				42		42				14					56	56

Table 6. Chromite production from Placer County, California (in long tons)—Continued

Property or shipper (S)	Map number	Pre-1916	1916	1917	1918	1919	Pre-1920 unofficial estimate*	1920-40		1941	1942	1943	1944	1945-49		Total	Total unofficial estimate*
								Year	Tons					Year	Tons		
New Hope					[2]		60										60
North Fork Chrome	15				[2]		[d](55)			[a]172	[a]46					218	218
Oak Patch	10							1920	[a]15							15	15
Parker	89				[b]400		500					5				405	505
Pitt	62?	[1]			[2]		50±										50±
Poco Tiempo Quartz	73				[a]35		35									35	35
Port Wine	29									[8]	[8]						?
Power Timber Co. property			[3, 4]	[3, 4]	[3, 4]		[6]	1920	[d](27)								
								1926	44							44	[1]
Randall	28									[7]	20					20	55
Red Pit	46										[7]						50
Schermeir prospect	66						[d](3)				[a]3					3	3
Scott	6			[b]143			143									143	150
Section 19	17			?	[2]		50±			[7]	[a]36					36	175
Section 24					[2]	[c]6	6									6	6
Smith and McCullom's Capco lease										122	74					196	196
Snakehead (Jumbo)	11				[a]17		17	1920	[a]48							65	65
Snow					[2]		10										10
Southern Pacific property	64, 65				[2]		125			[a]33		16				49	175
Spanish Mines Consolidated	74			46	36	[d](18)	100	1920	[d](18)							82	100
Sugar Pine Chrome			263	952	179		[6]									1,394	[6]
Sunny Ridge	33[c]			[4]	[4]		50±						[a]14	1945	5	19	70±
Sunny Ridge Fraction	36			[4]	[4]		100±				[a]29					29	130±
Sunset	54b, 55	[1]	[3]	[3]	[3]		300+	1920	[2]	[a]22	182	14	23	1945	20	261	561+
Turner and Geisendorfer (S)			78	529	424	[b]815	[6]	1920	[b]156							2,002	[1, 6]
Twin Shafts	50										[7]						25
Uvarovite	3			[2]	[2]		100										100
Victory Chrome Co. (S)										[a]250	430					680	[1, 6]
Vulcan												11				11	11
Washout	71									206	98	156	11			471	471
West Chrome	14		67	134		[c]54	255				[a]27					282	282
Wild Canyon	37c, 38a			[4]	[4]		75				[a]2					2	77
Williams, J. L. (S)								1930	20								
								1931	10							30	30

Yellow Pit	49											[7]						120
Unknown sources		2,900			1,355		3,250	1938	33			17				4,305	4,126	
Totals		2,900	646	2,755	3,383	1,166	10,788 ±		679	1,547	1,422	484	447		148	15,577	15,620 ±	
Federal totals			579	3,638	3,644	355			562									
State totals			691	3,828	4,431	857			906									

* Totaled separately. Estimates based on information obtained from all available sources.
[a] Apportioned, on basis of additional information, from combined production of two or more properties.
[b] Amount reported to California Division of Mines.
[c] Ore reported stocked at end of preceding year, presumably shipped during year shown.
[d] Ore reported stocked at end of preceding year, not added because some may be below shipping grade or because some may be included in the production for a subsequent year.
[e] Includes some ore from Calaveras and El Dorado Counties.
[f] Amount shown may include some ore from other counties, but does not include 279 tons of ore shipped from Auburn, all or part of which may have come from deposits in Humboldt and Siskiyou Counties.
[1] Included under "Unknown sources."
[2] Some production reported, but amount not specified. May be included in production credited to other properties or shippers.
[3] Included in production of Sugar Pine Chrome mine.
[4] Included in production of Turner and Geisendorfer.
[5] Included in production of Green's CAPCO lease, map no. 54a.
[6] Apportioned to various properties from which ore was obtained.
[7] Included in production of Victory Chrome Co.
[8] Included in production of R. N. Knudsen.

center of the north edge of the $NE\frac{1}{4}NW\frac{1}{4}$ sec. 19 and consisted of two adits, a crosscut, and a short raise. Numerous open cuts and pits were made on other parts of the property.

When Waring visited the property in June 1917 he found that an adit 65 feet long had been driven along a lens or series of lenses of ore about 2 feet wide. The strike of this ore was N. 25° E. From this adit a crosscut had been driven 25 feet to work a raise 10 feet high. A "cross vein" of ore, 2 feet wide at one place, had been followed by another adit 50 feet long. The strike of this ore was N. 60° W. and the dip was 50° SW. A pit about 6 feet in diameter, 60 feet higher than the level of the adits, had yielded about 1 ton of "granular" ore. Some float ore had been gathered up for shipment; one boulder of this float ore weighed about 3 tons.

Cameron reported in September 1918 that four lenses of ore from 2 to 4 feet wide had been mined up to that time; two lenses came from a crosscut adit and two from pits. He said no ore was showing in the pits, but much float remained on the property.

The lessor's records show that 111.2 short tons of ore was shipped from the property in 1917, 51.4 tons in 1918, 40 tons in 1919 (mined in 1918), and 40 tons in 1920. Approximately 20 short tons of ore stocked on the property in 1922 probably was shipped in a subsequent year. (Southern Pacific Land Co. 49; Cameron 18; Bradley 18; Waring 17)

Uvarovite(?) Claim (3)

According to D. J. Sullivan, several operators produced ore during World War I from one or two deposits on the Uvarovite(?) claim in the $SE\frac{1}{4}$ sec. 24, T. 16 N., R. 10 E. R. E. Linder and J. R. Hodges may have obtained about 40 tons of ore that had been mined prior to 1917; George Scott mined 20 or 30 tons in 1918; Charles Kempster and R. E. Linder mined about 30 tons from an open cut and tunnel in 1918; and an unidentified lessee mined about 10 tons in 1918. (Rynearson 49)

Hodge Ranch (4)

R. E. Linder and J. R. Hodges exploited two chromite deposits in 1916-18 on patented land they held in sec. 25, T. 16 N., R. 10 E. The property is known locally as the Hodge Ranch. At one deposit, which was located at an altitude of about 3,560 feet in the $NW\frac{1}{4}$ sec. 25, they mined 25 tons of ore from an adit 30 feet long and a raise 10 feet high and they gathered up 157 tons of float ore in 1916. The other deposit was about a quarter of a mile northeast at an altitude of about 3,950 feet and about 200 feet lower than the Pacific Gas & Electric Co. ditch. When Waring visited the latter deposit in 1917 a lens of ore striking N. 20° W. was partly exposed in a face 3 feet wide and 5 feet long. It appeared to him that the ore in this exposure might have slipped from an original position about 10 feet up the gulch, where some similar ore was exposed in a face 2 feet wide and 3 feet long. Waring reported that about 10 tons of ore containing about 35 percent Cr_2O_3 had been mined from the workings and he estimated that about 15 tons remained in place. The total amount of ore eventually yielded by the deposit is not known accurately, but the records available indicate that the deposits yielded approximately 163 long tons of ore in 1916, 80 tons in 1917, and 41 tons in 1918. About 40 long tons of the ore shipped in 1917 or 1918 may have come from deposits on the Uvarovite claim in sec. 24. (Bradley 18; Waring 16, 17)

Beat Claim (5) [37]

The Beat chromite deposit is one of the few deposits in the Sierra Nevada region from which chromite was mined and shipped during the years between World Wars I and II. It is located in the northwest corner of lot 18, sec. 6, T. 15 N., R. 11 E. Ore was discovered on the property by a man named Allen in 1917. D. J. Sullivan bought the claim from Allen in 1919 and has exploited the deposit intermittently since. L. J. Dunn leased and worked the claim for a short time during 1941.

The deposit occurs at and near the surface of what appears to be a weathered and somewhat eroded slide block. Part of the ore that has been taken from the deposit was mined from a system of tunnels driven a short distance below the pre-mining ground surface; the largest ore body mined in this way was about 4 feet wide, 6 feet high, and 30 feet long. Later, the area over and adjacent to the underground workings was sluiced to recover pieces of float ore in the weathered material and fragmental blocks of ore in the broken serpentine at the surface of the slide block. Dunn used a bulldozer to work the surface area to greater depths and recovered about 13 long tons of float ore. Although no ore could be seen in place in 1949, a few tons of float ore was piled on the property along with a few tons of low-grade ore from the Julian deposit. The ore in the float pile is massive and some is coarse-grained; the largest crystals of chromite are about one-half inch in diameter. A little uvarovite occurs in the ore. Most of the ore taken from the deposit to date has averaged about 55 percent Cr_2O_3.

Allen mined and sold 20 tons of ore to R. E. Linder and D. J. Sullivan and 20 tons to George Scott in 1918. Sullivan shipped ore from the Beat claim in 10 of the years of the period 1920-45; the following figures indicate the approximate amounts of the shipments and the years they were made: 15 tons in 1920, 90 tons in 1921, 142 tons in 1922, 50 tons in 1923, 24 tons in 1925, 100 tons in 1931, 38 tons in 1933, 13 tons in 1935, 35 tons by Sullivan and 13 tons by Dunn in 1941, and 15 tons in 1945. Figures for 1920-31 are in short tons and those for 1933-45 are in long tons. Some of Sullivan's shipments included a little ore from other deposits, but he cannot recall the exact amounts. It is estimated that about 500 long tons of the total of the amounts of ore noted above came from the Beat deposits.

A few tons of ore in the soil and mining debris undoubtedly could be recovered by bulldozer or hydraulic mining methods, but no estimate of additional reserves can be made until more work has indicated the presence of more ore in place. One approach to the search for additional ore would involve the removal of the overburden and mining debris at the northern and southern ends of the area already worked in an effort to demonstrate or disprove the possibility that other ore bodies occur along the strike of those already mined. Another approach could be an attempt to trace the float occurring north of the deposit to an ore body that still may remain in the northern part of the slide block. (Rynearson 49; Averill 41, 42)

Scott Claim (6)

George Scott mined some chromite in 1917 from a claim he held in the northwest corner of lot 19, sec. 6, T. 15 N., R. 11 E. His workings consisted of a series of shallow pits dug along a line about 150 feet long, a short drift underneath the southwestern pits, and a shallow

shaft in one of the northeastern pits. These workings are now caved or partly filled with waste, and no ore can be seen in place. The deposit apparently consisted of a series of small lenses of ore occurring along a sheared zone in the serpentine. Scott shipped 160 short tons of ore from the deposit in 1917. D. J. Sullivan mixed a few tons of Scott ore with the ore he shipped from the Beat claim in 1923 and 1925. A little work with a bulldozer at the northeast end of the series of pits could easily determine whether additional ore occurs along the strike of the ore zone. (Rynearson 49)

Julian Claims (7)

Charles Kempster and R. E. Linder located two claims during World War I on what is known as the Julian deposit. This deposit lies just north of the Southern Pacific railroad tracks near the line between secs. 5 and 6, T. 15 N., R. 11 E. A series of small open cuts and pits along a line trending N. 15° W. expose low-grade layered ore in a discontinuous ore zone from 4 to 6 feet wide and about 200 feet long. At one time the ore probably occurred in one continuous ore body, but shearing movements along the zone have broken the original ore body into many irregular and contorted segments. Some of the best ore in the zone probably contains 30 or 35 percent Cr_2O_3, but the tenor of the average ore is much lower.

Kempster and Linder sorted about 1 ton of low-grade shipping ore from 30 to 40 tons of milling-grade ore they mined in 1918. About 10 tons of the ore mined in 1918 has been hauled to the Beat claim for possible "sweetening" with the higher-grade ore from that deposit. Perhaps one or two thousand tons of milling-grade ore remains in the ore zone. The reserves are not sufficient to justify even a small milling operation, and it is probable that only a few tons of low-grade shipping ore could be sorted profitably from the most promising parts of the ore zone. (Rynearson 49; Cameron 18)

Dunbar Lease (8)

The Dunbar chromite deposit is near the east edge of lot 3, sec. 6, T. 15 N., R. 11 E., about 350 feet south of the railroad. The property was leased from the U. S. Forest Service (by a person named Dunbar?) and prospected by making an open cut about 50 feet long, 5 to 20 feet wide, and 2 to 10 feet deep at the contact between the old erosion surface on the serpentine and the overlying volcanic rocks. No ore was found in place but 2 or 3 tons of float was recovered. (Rynearson 49)

Iron Spring Claim (9)

D. J. Sullivan discovered a 7- or 8-ton boulder of chromite on the Iron Spring claim near the west edge of sec. 5, T. 15 N., R. 11 E., about 250 feet east of the southeast corner of lot 20, sec. 6. Charles Kempster and R. E. Linder broke up the boulder and shipped the ore in 1918. (Rynearson 49)

Oak Patch Claim (10)

D. J. Sullivan found two small chromite deposits near the crest of a spur ridge on the Oak Patch claim in sec. 5, T. 15 N., R. 11 E., about 500 feet southeast of the Iron Spring deposit. The lowest deposit was opened in 1919 or 1920 by an open cut 18 feet long and 2 to 6 feet wide with a shaft 12 feet deep in the bottom. Sullivan mined about 16 tons

of ore from a pod about 10 feet long and 5 feet in diameter. The ore body pitched steeply to the north in a shear zone that strikes north and dips about 85° W. A little disseminated ore was present along the margins of the main ore body, and some uvarovite and talc were associated with the ore. A pit 10 feet long, 6 feet wide, and 4 feet deep at the other deposit on the claim yielded 7 or 8 tons of ore in 1942. (Rynearson 49)

Snakehead (Jumbo) Claim (11)

The Snakehead or Jumbo claim is in lot 27, sec. 6, T. 15 N., R. 11 E. R. E. Linder and D. J. Sullivan mined two carloads (about 65 or 70 tons) of ore in 1918 from a deposit in a small outlying mass of serpentine on the claim. One kidney of ore near the surface was mined from an open cut about 30 feet long and 8 feet wide. A narrow stringer of ore below the upper kidney was followed down for about 5 feet to another kidney, which was mined from a shaft 25 or 30 feet deep. The ore contained about 47 percent Cr_2O_3. (Rynearson 49)

Lucky Strike Claim (12)

According to D. J. Sullivan, a small chromite deposit near the center of sec. 6, T. 15 N., R. 11 E., was mined from the Lucky Strike claim in 1918. The deposit yielded 15 or 20 tons of ore from one open cut 25 feet long and 8 feet wide, another open cut 10 feet long and 6 feet wide, and a shaft about 10 feet deep. The writer has not been able to find out who mined and shipped the ore. (Rynearson 49)

Forest Hill Divide Area

West Chrome Mine (13, 14)

W. N. West opened three chromite deposits in the canyon of the North Fork of the American River during World War I. The largest of these (Knob Hill?) is located in the northwest corner of the NE¼ sec. 12, T. 15 N., R. 10 E., on the west side of a canyon tributary to the river. A much smaller deposit (also known as the West prospect) is located on the same side but near the mouth of this canyon in sec. 1. The location of the third deposit is not known. West made one open cut in mining part of the ore in the larger deposit. H. A. and C. A. Geisendorfer enlarged this cut during 1942. The deposit in sec. 1 was prospected by a small open cut, but only a little ore was found.

Records of the U. S. Geological Survey show that West reported shipments of 67 long tons of ore in 1916, 134 tons in 1917, and stocks of 54 long tons on hand in 1918. Records of the California Division of Mines, however, indicate that he shipped 88 short tons of ore in 1918. The ore shipped in 1917 reportedly contained 54 percent Cr_2O_3 and that shipped in 1918 contained 42 to 52 percent Cr_2O_3. The Geisendorfer brothers mined and shipped 27.3 long tons of ore from the deposit in 1942. This ore contained 44.84 percent Cr_2O_3 and 11.44 percent Fe with a Cr to Fe ratio of 2.66. All the ore shipped was packed by horses over a trail to Towle on the north side of the river. According to H. A. Geisendorfer, some ore remains in the larger deposit, but it is "bunchy" and would be difficult to mine. (Rynearson 49; Bradley 18; Waring 16)

North Fork Chrome Mine (15)

The North Fork Chrome mine is in the $SE\frac{1}{4}NW\frac{1}{4}$ sec. 7, T. 15 N., R. 11 E., on the west side of a tributary canyon south of the North Fork

of the American River. The deposit was opened originally by Joseph Wherry, Frank Bonham, and Melvin Russel in 1918 under a lease from the Central Pacific Railroad Co. Although these men retained their lease until 1931, they did not ship any of the 63 tons of ore mined by them in 1918. H. A. and C. A. Geisendorfer worked the deposit during 1940-43 under a lease from the Southern Pacific Land Co. They built a bulldozer trail to the deposit and enlarged the old open cut to a hole about 15 feet long and 15 feet deep (fig. 2). The ore was packed by horses (fig. 3)

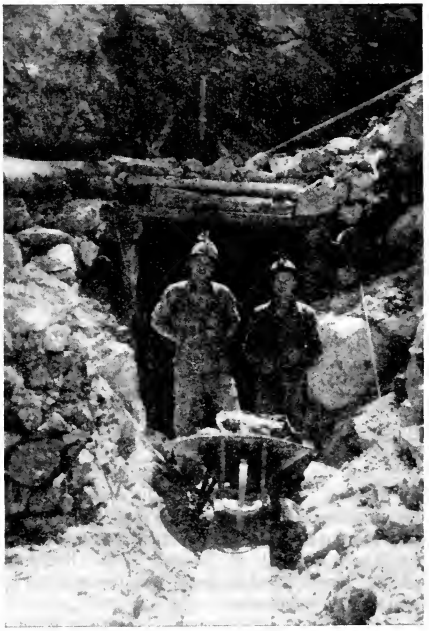

FIGURE 2. Open cut at North Fork Chrome mine, Placer County. Photo taken in 1942.

up the bulldozer trail to the road on the rim of the Forest Hill Divide. The Geisendorfer brothers shipped 58.6 long tons of ore mined by the previous operators and 113.7 long tons of newly mined ore to Auburn in 1941; this ore averaged 46.64 percent Cr_2O_3. They shipped 45.9 long tons of ore containing 45.18 percent Cr_2O_3 and 11.89 percent Fe, with a Cr to Fe ratio of 2.60, to Auburn in 1942. (Rynearson 49; Southern Pacific Land Co. 49; Averill 41, 42)

Smith and McCullom Prospect (16)

H. A. Smith and Bruce McCullom prospected a small low-grade chromite deposit in 1941 in the extreme northwest corner of sec. 18, T. 15 N., R. 11 E. They apparently found that the deposit was small and the ore

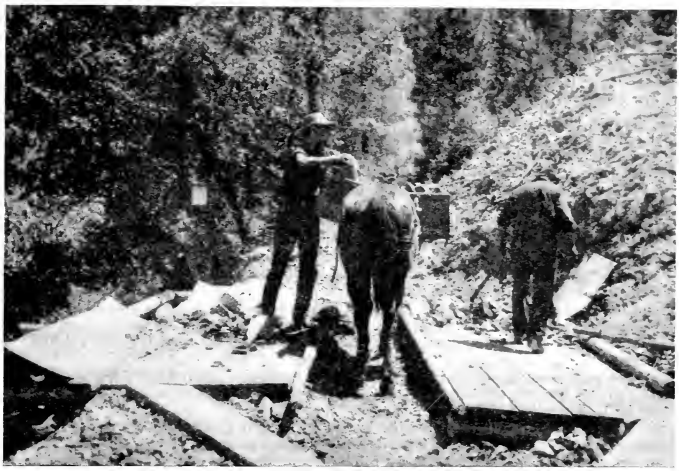

FIGURE 3. Loading ore on a pack horse at North Fork Chrome mine, Placer County. Photo taken in 1942.

very low in grade, as none of the ore was shipped. (Southern Pacific Land Co. 49)

Sugar Pine Chrome Mine [39]

One of the principal chromite mining enterprises in the central part of the Forest Hill Divide area during World War I was operated by R. C. Turner et al., under the name of Sugar Pine Chrome mine. This "mine" included many scattered deposits in secs. 19, 20, 29, and 31, T. 15 N., R. 11 E., on lands leased from the Power Timber Co. Information concerning the operation and organization of the Sugar Pine enterprise is scanty. Turner apparently acted principally as an agent and shipped ore for several other people who participated in the actual mining operations under contracts and subleases. Among those who mined the ore were Jessie Butler, Ed Turnbull and Ed Powell, and Joseph Del Mue. Harold Power, the owner of most of the property that was worked, evidently mined some of the deposits independently.

The largest of the Sugar Pine deposits was that mined by Butler from the Boiler Pit in the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 29. Most of the other principal deposits were in the $W\frac{1}{2}NE\frac{1}{4}$ and the $E\frac{1}{2}NW\frac{1}{4}$ sec. 31, and included some of those that were worked subsequently by C. L. Mathews, Dart and Braden, V. S. and H. R. Marall, and T. C. Green. Waring (17) examined and reported on some of the deposits that were being worked in 1917. Although some of the old workings still were evident when the writer visited the area in 1943, 1949, and 1950, many had been modified and some obliterated, and it is impossible to correlate all the deposits described by Waring with those that were reworked during World War II. The Boiler Pit deposit is the only one that has been correlated definitely, and it is described under a subheading under Victory Chrome Co. Because of uncertainty in identification, Waring's other descriptions have

not been incorporated in the separate descriptions of the deposits worked during the World War II. However, his descriptions may provide clues that will be useful in planning any further exploitation of the deposits, and they are quoted below with added reference [in brackets] linking them to groups of deposits that are described elsewhere in this report.

"At an elevation of 3600′, in Sec. 31, a 16′ shaft exposes soil carrying decomposed chrome for a depth of 10′ and solid chrome ore for the lower 6′. The ore body is 8′ wide, has been opened up for a distance of 14′, and appears to strike east-west with a pitch of 50° to the south. Approximately 40 tons of ore had been corded, which appeared to carry about 50% Cr_2O_3. [Maralls' CAPCO leases and Green's CAPCO leases]

"On a ridge about ¼ mile above the last working a 16′ incline had been run in weathered chrome. The ore body strikes east-west, at an elevation of 3700′, and the upper portion of it has apparently migrated down the hill in course of weathering. The main ore body pitches rather steeply to the south, at an angle of about 65°, while the upper portion pitches only 10°-20° south. About 40 tons of ore had been taken out up to June 17, 1917. The surface rock carries a great deal of iron oxide, much of which is in shot-like nodules; this is red on the surface and yellow below. [Dart and Braden, Maralls' CAPCO leases, and Green's CAPCO leases]

"Six men were employed in these scattered workings (includes the Boiler Pit). The upper, fine ore was more or less mixed with soil and was being concentrated by R. L. Turner and C. A. Geisendorfer.

"A large pit in Sec. 31, at an elevation of 3520′ and southwest of the last workings, exposed an ore body striking N. 80° W. and pitching 80° N. The upper 6′ of ore had only a slight northerly pitch. About 60 tons of ore were corded. In an old open cut 6′ deep and 50′ long ore was exposed 2′ wide for a distance of 30′. Just south of the pit, open cut work had been done, over an area 20′x40′, and considerable float chrome recovered. About 40 tons are said to have been shipped in the fall of 1916 and 30 tons more were piled for shipment from an area 150′ farther east. Still farther south is an old shaft, filled with water, which had been worked in 1884-85. Northwest of the pit an open cut, made in early days, had been run N. 40° W. for a distance of 250′; at the southeast end of it a pit 14′ in diameter and 10′ deep had been sunk and considerable ore taken out. [Sunset]

"Farther north in the same section, at an elevation of 3510′, an open cut had been made in a line N. 50° W. The open cut was 5′ deep and 150′ long and 20 tons of ore had been taken out, which assayed 55% Cr_2O_3 and 2% SiO_2." [Sunset ?]

R. C. Turner is credited with a total production of 1,394 long tons of ore by the U. S. Geological Survey and 1,422 tons by the California Division of Mines. It is likely, however, that at least a small part of the ore Turner shipped came from deposits other than those described above. (Cameron 18; Bradley 18; Waring 17)

Turner and Geisendorfer Chrome and Concentrator Company [38]

Another of the major chromite mining enterprises in the central part of the Forest Hill Divide area during World War I was operated by R. L. Turner and C. A. Geisendorfer, who mined or purchased ore from numerous deposits and also concentrated low-grade material from their own as well as other deposits. As in the case of the Sugar Pine Chrome mine, the details of the Turner and Geisendorfer enterprise are not available. Their operations were centered around deposits in the $S\frac{1}{2}NE\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$, and $SE\frac{1}{4}SW\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E., but they also worked deposits in the adjoining secs. 20, 31, and 32 and in sec. 5, T. 14 N., R. 11 E. Some of these deposits are shown on plate 14 at localities numbered 26(?), 35e, 37b, 37c, 38a, 38c, 38d, 39, and 56. As most of these deposits were reworked during World War II, they are described elsewhere under separate headings.

The concentrator (38b on pl. 14) was located in the southwest corner of the SE¼ sec. 30. It was used to concentrate "fines" and chromite-bearing soil from the upper portions of weathered ore bodies in nearby deposits. The coarse fragments were screened from the low-grade material, and the material that passed the screen was concentrated on two Dykes tables. The total amount of concentrate made is not known.

Records of the U. S. Geological Survey credit Turner and Geisendorfer with a total production of 1,051 long tons of ore, whereas those of the California Division of Mines credit them with 1,527 tons. A large part of the ore shipped by Turner and Geisendorfer was purchased from other operators. (Rynearson 49; Cameron 18; Bradley 18; Louderback 18; Waring 17)

Victory Chrome Company

The Victory Chrome Co., a partnership of Charles Hopper Brown, Jerry Grant, Ray Graetz, and J. L. Garnette (until 1942), carried on the most extensive of the chromite mining operations in the Forest Hill Divide area during World War II. Most of the ore produced by this company came from deposits on properties leased from others. Properties in T. 15 N., R. 11 E., that were worked by the company included Capital Co. holdings in parts of secs. 19, 28, 29, and 32, the Iowa Hill No. 1 claim in sec. 19, and the Bessie B. and Lightning Ridge claims in sec. 30. Those in T. 14 N., R. 11 E., included holdings of Charles L. Finning et al. in parts of secs. 5 and 6 and Ben Schuler's Mountain View claims in sec. 20. The company also constructed and operated a small washing and concentrating plant in the southwest corner of sec. 28, T. 15 N., R. 11 E., which was used to recover chromite from detrital material.

Like several other operators who produced chromite from the area during World War II, the Victory Chrome Co. used the bulldozer extensively in its mining operations. In numerous places, where chromite float was found or where chromite had been mined previously, prospecting was done by using a bulldozer to make trenches at intervals across the chromite-bearing areas or to scrape off the soil and weathered rock adjacent to known deposits. In most of the areas so prospected the overburden of red and yellow clay and soil was quite thick and it was necessary to make some of the bulldozer workings as much as 15 feet deep to expose the underlying bedrock. While prospecting for ore bodies in place, the operators unearthed many chunks of lump chromite, some as much as a foot in diameter; the larger chunks were grubbed from the loosened soil by hand. Such prospecting led to the discovery of several ore bodies in place, and these were mined from small open cuts and pits or from shallow shafts. In at least two deposits the upper portions of the ore bodies were partly disintegrated as a result of weathering in place, and this friable ore was rich enough to be shoveled up and shipped directly without sorting or other concentration. The soil adjacent to these disintegrated ore bodies and the soil in a few other places, where ore bodies were not found actually in place but were broken up and the chromite was dispersed through the top soil, contained sufficient chromite (5 to 20 percent Cr_2O_3) to warrant concentration at the washing plant. Perhaps 1,000 tons or more of such material was trucked to the plant for concentration.

The washing plant (47), which was constructed rather roughly, consisted of a trommel 20 feet long and 4.5 feet in diameter with one-half inch perforations in a section 5 feet long at the discharge end, a battery of jigs, and a belt stacker that doubled as a picking belt. The loose chromite-bearing material was fed into the trommel and washed with a heavy charge of water. The minus one-half inch material was circuited over a double-cell Pan American jig and thence over two Miner's Foundry jigs. The oversize from the trommel was discharged onto the stacker, where the larger fragments of chromite were picked off by hand. Although the plant was relatively efficient in concentrating the chromite, the washing process did not completely remove the limonitic coating from the chromite fragments and the jig concentrate contained a considerable amount of limonite "shot"—small pellets of hydrous iron oxides commonly found in soils developed from serpentine. Consequently, the concentrates, though high in chromic oxide, were also high in iron. Although many thousands of yards of soil containing more than 10 percent chromite probably could have been mined from various localities within hauling distance of the plant, any concentrates made from such material would have had an undesirable Cr to Fe ratio. Furthermore, the water supply was scarce and limited to the rainy season, when mining and trucking the low-grade material would have been difficult. Therefore, the company treated only the richest material from two or three deposits close to the plant.

Complete and accurate records of the amounts of ore produced by the Victory Chrome Co. from deposits in Placer County are not available, and the discrepancies in the figures that have been recorded by State and Federal agencies cannot be reconciled. The figures tabulated below were compiled from data supplied by the company and by stockpile agents for the years 1941 and 1942 and from Metals Reserve Co. records for 1943 and 1944. Although these figures may not be complete, it is believed that they are representative of the actual production.

Table 7. Placer County chromite production by Victory Chrome Company

Year	Kind of ore	Long tons	Percent Cr_2O_3	Percent Fe	Cr/Fe
1941	Lump (mostly)	295.5	47.52	----	----
1942	Lump (mostly)	171.0	41.44	13.49	2.10
	Fine (friable ore)	131.1	49.28	19.79	1.70
	Concentrates	127.5	47.06	18.83	1.71
1943	Lump	8.9	46.55	15.07	2.11
1944	Lump	42.9	48.37	12.65	2.62
	Total	776.9			

Descriptive information is not available for all the deposits in the Forest Hill Divide area that were worked by the Victory Chrome Co. Many of the localities prospected seem to warrant no separate description. Most of the principal workings have been visited by Federal representatives, but these visits were not generally made until after the workings had been abandoned and had sloughed or caved. Consequently, but little information on the geologic details of the deposits is known. However, it seems worth while to attempt a brief description of each of

the principal deposits—giving their location, production, and what is known about the size, shape, and occurrence of the ore bodies—in the hope that such information, though sketchy and incomplete, may be useful in the further exploitation of these deposits. It should be noted that estimates of the amounts of ore yielded by individual deposits are approximate; some may be too high and others too low.

Section 19 (17). A chromite deposit in the $NE\frac{1}{4}NW\frac{1}{4}$ sec. 19, T. 15 N., R. 11 E., yielded about 90 long tons of ore to the Victory Chrome Co. in 1941. This ore was mined from an old shaft that had been made during World War I. This deposit is probably identical with one worked later by the War Metals Development Co., which mined about 36 long tons of ore from two shafts about 25 feet deep. These two shafts are about 50 feet apart and, although they were not accessible when the deposit was visited by the writer in 1943 and 1949, they appear to be connected underground by irregular stopes. It is said that a small lens of ore remains in the bottom of one shaft. The ore occurs in relatively unaltered dunite and consists of irregular stringers, small masses of poorly formed nodules, and coarse, disseminated grains of chromite. Neither the grade nor the total amount of the ore shipped from this deposit are known. (Rynearson 43, 49)

Randall Claims (28). According to C. H. Brown, the Victory Chrome Co. produced about 35 long tons of ore from D. O. Randall's claims in the $NW\frac{1}{4}NE\frac{1}{4}$ sec. 30. Presumably these are the same claims that Randall called the Randall No. 1 and No. 2 and from which, in 1942, he himself shipped 20 long tons of ore containing 51.37 percent Cr_2O_3 and 13.9 percent Fe with a Cr to Fe ratio of 2.57. The workings consist of several shallow pits and trenches south of a small gully and a wide, shallow cut and a shaft (now filled) north of the gully. A little disseminated ore is on the dump near the shaft and numerous small pieces of float can be found in the vicinity of the workings, but no ore can be seen in place. (Rynearson 49)

Bessie B. (40) and Lightning Ridge Claims. The Victory Chrome Co. reported that the 42.9 long tons of ore it shipped in 1944 came from the Bessie B. and Lightning Ridge claims, but did not report the amounts that came from each. The Bessie B. claim adjoins the Daisy Bell and the Blue Bell and/or Bee Bee claims in the southeast corner of the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 30. The Victory Chrome Co. workings are those just east of the road. About 25 tons of the ore mined in 1944 came from a shaft about 20 feet deep, and a few tons of ore was taken from surface workings near the shaft by C. H. Brown and an additional few tons by Joseph Del Mue afterwards. The location of the Lightning Ridge claim has not been verified, but the name possibly alludes to the *Lightning Streak No. 1 claim (37a)* in the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 30, from which Brown is said to have mined a few tons of ore. (Rynearson 49)

High-grade Pit (45). Most of the friable ore shipped by the Victory Chrome Co. came from a deposit at the High-grade Pit on the west edge of the road in the $NE\frac{1}{4}SE\frac{1}{4}$ sec. 29. The ore bodies in the deposit were found essentially in place, and the friable character of the ore was the result of decomposition by weathering processes. The chromite at the margins of the ore bodies was mixed with soil, and some of this low-grade material was concentrated at the washing plant. No hard lump ore was

found in place but about 12 long tons of hard float ore was grubbed out of the soil dug up in the vicinity by a bulldozer. This deposit yielded an estimated 130 long tons of ore. (Rynearson 43, 49)

Red Pit (46). A large area near the multiple road intersection in the southwest corner of sec. 28 was scraped with a bulldozer. The red soil in a part of these workings known as the Red Pit was relatively rich in chromite (averaging about 7 percent Cr_2O_3) and was trucked to the washing plant; it yielded about 50 long tons of concentrate. (Rynearson 43)

Long Pit and Yellow Pit (49). In the southeast corner of sec. 29 an area about 400 feet long and 30 feet wide was trenched and scraped with a bulldozer to depths of 1 to 8 feet. The scraped area in the northern part of these workings was called the Long Pit, and near the north end of this pit a small lens of ore was mined from a small open cut in the serpentine exposed by the bulldozer. This ore body was about 2 feet wide and 8 feet long and yielded about 30 long tons of ore. The southern part of the workings, known as the Yellow Pit, yielded 50 or 60 long tons of lump and friable chromite. A roughly equivalent amount of concentrate was made from the chromite-rich portions of the yellow soil (averaging about 10 percent Cr_2O_3) mined from the pit. Some of the ore mined by T. C. Green in 1944 may have come from these same workings after they had been abandoned by the Victory Chrome Co. (Rynearson 43, 49; Robertson 42)

Twin Shafts (50). The company made a bulldozer pit about 50 feet long, 30 feet wide, and 4 feet deep and exposed two small, irregular ore bodies about 20 feet apart in the serpentine in the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 29. Robertson reported that about 23 long tons of ore had been mined from two shafts 20 feet deep in September 1942 and that ore about 2 feet wide was being mined at the bottom of one shaft. It is assumed that all the ore in both ore bodies was mined out. (Robertson 42)

Capp's Pit (51). A small deposit known as Capp's Pit is located in the southeast corner of the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 29. In 1942 the Victory Chrome Co. mined about 20 long tons of ore from a small open cut near the bottom of the shallow gulch. (Rynearson 49; Robertson 42)

Boiler Pit (41). The Boiler Pit deposit in the northwest corner of the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 29 was opened in 1916 by Jessie Butler for R. L. Turner. It has the distinction of being the largest individual deposit that has been found thus far in the Forest Hill Divide area, and it is the only one that has yielded more than 1,000 tons of ore. The workings are in the bottom of a gully just north of the road. In 1949 the surface workings consisted of a narrow, irregular open cut about 100 feet long with two deeper holes (stope openings?) about 15 feet apart at the southeast end. About 25 feet south of the two holes is the collar of a shaft or incline, which may be the incline that Waring described as being about 40 feet deep. The two holes and the shaft are flooded. No ore can be seen in any of the accessible workings. According to Waring's description, the ore body mined by Butler was from 3 to 9 feet thick, about 50 feet long, and extended to a depth of at least 40 feet. This ore body yielded approximately 1,000 long tons of ore containing about 45 percent Cr_2O_3. All of this ore was mined

in 1916 and 1917, and it is not known if any ore was left in the bottom of the World War I workings. In 1941 the Victory Chrome Co. produced 12 or 15 long tons of ore from the northwestern end of the open cut, but apparently no attempt was made to reopen the old underground workings. Because of the relatively large size of this deposit, additional exploration at the ends of the cut and below the old workings might disclose the presence of a considerable amount of ore. (Rynearson 49; Bradley 18; Waring 17)

Finning Property (60, 63). In 1941 the Victory Chrome Co. reopened two small deposits that had been worked during World War I, possibly by W. I. Hewes and O. H. Jones. Both deposits are on property owned by Charles L. Finning et al. One is in the northeast corner of the $NW\frac{1}{4}SW\frac{1}{4}$ sec. 5, T. 14, N., R. 11 E. It yielded about 25 long tons of ore, about 20 tons of which had been piled at the deposit since 1918. The other deposit is in the southwest corner of the $NE\frac{1}{4}NE\frac{1}{4}$ sec. 6. The old workings yielded about 5 long tons of ore in 1941. (Rynearson 50)

Mountain View Group (70). Ben Schuler owns the Mountain View group of three claims in the $SW\frac{1}{4}SW\frac{1}{4}$ sec. 20, T. 14 N., R. 11 E. The property was called the Manzanita Chrome mine in 1918 when it was owned by M. F. Hoffman and operated by Henry Schermeir. The workings comprise several pits and bulldozer trenches, a short inclined drift, and a shaft about 18 feet deep. No ore can be seen in place in the surface workings, but Schuler claims that narrow stringers of chromite remain in the bottoms of the underground workings. The small ore bodies apparently occur along an east-trending zone in dunite and in residual soil derived from dunite. It is reported that about 60 tons of ore was shipped from the deposit during World War I. An unidentified operator shipped 16 long tons of ore in 1941. The Victory Chrome Co. shipped 46 long tons of ore containing 47.8 percent Cr_2O_3 from the deposit in 1941 and about 9 tons of similar ore in 1943. Much float ore is scattered about the workings and some has been collected into small piles. Several tons of float ore could be recovered with little effort. Additional prospecting with a bulldozer might uncover other ore bodies. The most effective way to initiate further exploration would be to cut several deep trenches across the apparent trend of the ore zone. (Rynearson 50; Averill 42)

Miscellaneous Prospects. In addition to the deposits described above, the Victory Chrome Co. prospected occurrences of float ore at numerous scattered localities in secs. 19, 20, 28, 29, 30, T. 15 N., R. 11 E. Some of these prospects are shown on plate 14 as localities numbered 18, 21a, 21b, 21c, 42, 43, and 44. About 35 long tons of float ore was gathered up near locality 42 and about 12 long tons near locality 41. Most of the other prospects yielded no ore. (Rynearson 49)

Esther and Phyllis Mine (19, 20)

The Esther and Phyllis mine is the name that was adopted by the War Metals Development Co., Ltd., of which D. D. Pettigrew was the principal, for its chromite mining operations in the Forest Hills Divide area during 1941-43. This company worked deposits on Capital Co. lands in secs. 19 and 20, T. 15 N., R. 11 E., under a sublease from the Victory Chrome Co. Joseph Del Mue's Lucky Hunter claim (22) in the $SW\frac{1}{4}$ sec. 20 also was leased.

The operations, which were carried on by Pettigrew, were similar to those by the Victory Chrome Co. but were not nearly as extensive. Pettigrew mined some ore from the Section 19 deposit (17) in the $NE\frac{1}{4}NW\frac{1}{4}$ sec. 19 (see Victory Chrome Co.) and a little ore from the Lucky Hunter claim in sec. 20, but most of the ore he produced came from a group of workings in the $W\frac{1}{2}SE\frac{1}{4}$ sec. 19 (20b-20f). These workings comprise a series of bulldozer pits, small open cuts, and a shallow shaft (20f) extending for about 1,500 feet along a line trending N. 45° W. About 10 long tons of ore was taken from an ore body found in place in the serpentine in one open cut (20d). A few tons of disseminated ore containing 25 to 35 percent Cr_2O_3 was taken from the same cut and from the shaft but was not shipped. Most of the ore produced from these workings consisted of float and small bodies of weathered chromite occurring at the surface or in the red residual soil. Some of the soil also contained enough detrital chromite (5 to 20 percent Cr_2O_3) to induce the company to construct a washing and concentrating plant (19) in the hope that a considerable amount of such chromite could be recovered. The plant was similar to the one operated by the Victory Chrome Co. and had the same disadvantages in that the process could not eliminate the limonitic coating and limonite pellets from the concentrate. Up to February 1943 about 15 tons of concentrate, 11 tons of which contained 39.9 percent Cr_2O_3 and 24.8 percent Fe, had been produced in the plant.

The Esther and Phyllis mine is credited with a production of 137 long tons of ore averaging 47.67 percent Cr_2O_3 for 1941, 47 tons averaging 46.89 percent Cr_2O_3 and 10.52 percent Fe with a Cr to Fe ratio of 3.05 for 1942, and 32 tons averaging 44.73 percent Cr_2O_3 and 15.62 percent Fe with a Cr to Fe ratio of 1.96 for 1943. The accredited production totals 216 long tons, but some additional ore mined by the company probably has been included in the production credited to others who operated in the same area. (Rynearson 43, 49)

Iowa Hill Chrome Mine (23-25)

W. S. Macy, Wm. Hales, and W. S. Hales owned the four patented Iowa Hill Chrome claims in the $SW\frac{1}{4}$ sec. 19 and the $NW\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E., during World War I. O. S. Williamson and C. Beck leased and operated the Iowa Hill No. 2 claim in 1917, but the owners worked the property themselves in 1918.

Waring visited the property in June 1917 and reported that about 5 tons of float had been taken from a pit on the southwest side of the old road in the northwest corner of the $SW\frac{1}{4}SW\frac{1}{4}$ sec. 19 and that 2 tons of float ore was piled near an old shaft about 300 feet east of the pit. The lessees were mining a lens of ore about 5 feet wide and 16 feet long in another deposit at the south end of the claim in sec. 30. They also had opened still another lens of ore about 10 feet to the north in a small cut 3 feet wide and 12 feet long. Waring was told that 100 tons of ore had been mined several years previously from still another deposit in a large cut over the hill to the south of the sec. 30 workings. This last deposit probably was not on the Iowa Hill property.

The owners were working the deposits in sec. 19 when Cameron visited the property in June 1918. They had mined about 30 tons of ore, and some ore still showed in the bottoms of a series of pits that extended for 150 feet along a line trending N. 30° W. Apparently no ore was mined after 1918, and in 1949 only a few lumps of chromite and a little dis-

seminated ore could be seen scattered about the workings. The Victory Chrome Co. prospected some float with a bulldozer at one locality (23), but did not find enough ore to make a shipment.

Records of the U. S. Geological Survey credit Williamson and Beck with a production of 201 long tons of ore in 1917 and the Macy Bros. with 96 long tons in 1918. The Macy Bros. reported their ore stocks to be 29 long tons at the end of 1918, but this ore probably was shipped at a later date, as no evidence of it could be seen on the property in 1949. (Rynearson 49; Bradley 18; Cameron 18; Louderback 18; Waring 17)

Dart and Braden (29-32, 54a)

During 1941-42 H. A. Dart and W. L. Braden held leases on the Port Wine (29) and Horseshoe (30) claims of L. E., E. D., and J. W. Drone as well as leases on several other claims in the E½ sec. 30, T. 15 N., R. 11 E., and at various intervals during the same period they held leases from the Capital Co. on about 500 acres of land in sec. 31 and 120 acres in sec 32. Dart and Braden's mining operations were confined largely to several deposits on the claims in sec. 30 and one deposit in the SW¼NE¼ sec. 31. They constructed and operated a small washing plant (31) on the Horseshoe claim in the NE¼NE¼ sec. 30.

Dart and Braden and several other operators gathered up float ore and also mined a number of small lenses of ore in place at scattered localities in sec. 30 during 1941. Most of this ore was shipped by R. N. Knudsen to the U. S. Vanadium Co. stockpile at Auburn, but no records were kept of the amounts of ore taken from each deposit or of the total amount produced. According to Knudsen, he shipped well over 150 long tons of ore from the deposits.

The washing plant (31) on the Horseshoe claim was erected to concentrate some of the ore found in a deposit on the hillside above the plant. The ore in this deposit consisted partly of float and partly of stringers and disseminated crystals of friable chromite occurring in a small, irregular mass of dunite in saxonite. About 12 long tons of the float was gathered up and shipped. An irregular open cut about 200 feet long, 5 to 30 feet wide, and 5 to 15 feet deep was made in mining the remainder of the ore. Most of the mining was done by means of a stream of water from a 2-inch nozzle. First the detrital material and then the decomposed ore in place was sluiced into a flume, which transported the material to a series of eight riffle boxes, which discharged onto two Pan American jigs. The plant was operated during the first six months of 1942 and produced 62.7 long tons of concentrate averaging 47.39 percent Cr_2O_3 and 15.71 percent Fe with a Cr to Fe ratio of 2.06.

Dart and Braden also mined some ore in 1942 from an old shaft in the SW¼NE¼ sec. 31 on the ridge east of the Sunset mine (Dart and Braden's Capco lease (54a)). This shaft probably was a part of the old Sugar Pine workings (see Sugar Pine Chrome mine), from which more than 40 long tons of ore was mined during World War I. Dart and Braden found some more ore in or adjacent to the old workings and took out 49.2 long tons of ore containing 50.39 percent Cr_2O_3 and 15 percent Fe. This same deposit may have yielded some additional ore to V. S. and H. R. Marall or to T. C. Green in 1943 or 1944. (Rynearson 43, 49; Averill 43)

Sunny Ridge Claim (33c)

Joseph Del Mue mined some ore in 1942 or 1944 from deposits on the Sunny Ridge claim in the northeast corner of the SW¼SW¼ sec. 30, T.

15 N., R. 11 E. Ed De Kruse and others had mined ore from these deposits during World War I. Del Mue extracted about 10 long tons of ore from one pit above the road; he states that a little ore about 1 foot wide still remains in the bottom of this pit. He also mined about 4.5 long tons of ore from another pit just below the road. The total amount of ore production from these deposits is not known. (Rynearson 49)

Buzzard and Blue Jay Claims (33a, 34a, 34b)

The Buzzard and Blue Jay claims include several pits in the southwest corner of the $NE\frac{1}{4}SW\frac{1}{4}$ and perhaps another pit in the $NW\frac{1}{4}SW\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E. Several small deposits in this area were worked by a man named Webber during World War I and reworked by V. S. and H. R. Marall during World War II. The early production is not known, but 79.3 long tons of ore containing 49.47 percent Cr_2O_3 and 12.15 percent Fe with a Cr to Fe ratio of 2.78 was shipped from two of the deposits by the Maralls during 1942-43. (Rynearson 49; Averill 43)

Lightning Streak Claims (33b, 33d, 33e, 37a, 37b)

The Lightning Streak claims are in the $SW\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E. The Victory Chrome Co. mined 2 or 3 tons of ore from a small deposit (37a) on the No. 1 claim in the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 30. Another small deposit (37b) a short distance to the south yielded about 5 tons of ore to R. L. Turner and C. A. Geisendorfer during World War I.

Joseph Del Mue mined about 25 long tons of ore from a pit (33b) close to the road on the No. 2 claim near the south edge of the $NW\frac{1}{4}SW\frac{1}{4}$ sec. 30. John and/or Arthur Watts mined 50 to 75 tons of ore from this same deposit, which they called the Black Cat (?), during World War I. Their ore probably was sold to one of several buyers, as the production has not been recorded separately.

Del Mue also mined about 8 long tons of ore in 1945 from a shaft (33d) 25 feet deep at a deposit about 300 feet southeast of the pit mentioned above. However, it is not known whether this shaft is on the No. 2 or on some other claim. (Rynearson 49)

Wild Canyon Claim (35c, 37c, 38a)

The Wild Canyon claim apparently includes a shaft (38a) about 20 feet deep and several small pits (35c, 37c) near the east edge of the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E. R. L. Turner and C. A. Geisendorfer mined ore from some of these workings during World War I. They took 60 or 70 tons of ore from the shaft and smaller amounts from other places. T. C. Green prospected around some of the old workings with a bulldozer, but recovered only about 2 tons of ore from one locality (37c). Joseph Del Mue and W. Zimdars also mined a few tons of ore from this claim in 1942.

Chucho Claim (35a, 35b)

The Chucho claim lies north and a little west of the Wild Canyon claim and is in the southeast corner of the $NE\frac{1}{4}SW\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E. The prospects on this claim yielded about 1.5 tons of ore to L. J. Dunn in 1941, about 2 tons to Del Mue and Zimdars in 1942, and about half a ton to T. C. Green.

Sunny Ridge Fraction Claim (36)

The Sunny Ridge Fraction claim in the northern part of the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E., was held by Joseph Del Mue et al., in 1942.

Ed Drone mined an unknown amount of ore from an open cut and a short drift near the southeast end of the claim during World War I, and Del Mue produced about 30 long tons of ore from other parts of the claim in 1942. Most of Del Mue's ore consisted of float derived from small ore bodies that had been eroded out of the highly sheared serpentine. (Rynearson 49)

Blue Bell and Bee Bee Claims (38c, 38d)

In 1941 L. J. Dunn reworked several deposits on two claims he called Blue Bell and Bee Bee (or B. B.). These deposits lie on both sides of the Forest Hill-Iowa Hill road near the south edge of the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E. Jessie Butler had dug some float during World War I from one deposit below the road. Dunn used a bulldozer to rework the same deposit and produced about 25 long tons of ore from several small ore bodies that the bulldozer uncovered in one cut and also a few tons of float. He also used his bulldozer to prospect one or two deposits that Turner and Geisendorfer, H. T. Powers, and perhaps others had opened on the southeast side of the road, and he probably recovered a few tons of ore during the course of this prospecting. Dunn's total production from these deposits amounted to about 35 long tons of ore averaging 49.87 percent Cr_2O_3; all the ore was shipped by R. N. Knudsen. (Rynearson 49)

Daisy Bell Claim (39)

The Daisy Bell claim, which is owned by Joseph Del Mue et al., is on the south edge of the $SE\frac{1}{4}$ sec. 30, T. 15 N., R. 11 E., and adjoins the Bessie B. and Blue Bell or Bee Bee claims. A series of deposits along the bottom and sides of a gulch on the claim apparently represent a southeastward continuation of the ore zones worked by Dunn and the Victory Chrome Co. According to Del Mue, considerable ore was mined from several of the deposits during World War I. A few of the old workings still are evident, but most have been obliterated or covered up by more recent work. Outcrops are scarce and so deeply weathered that but little can be ascertained regarding the geology of the deposits. However, the distribution pattern of the known deposits suggests that the ore bodies occur along at least two parallel ore zones in the serpentine. Because these ore zones may contain other ore bodies not yet discovered, it seems worthwhile to relate what is known about the size and location of the ore bodies that have been mined already, as such information might help to guide future exploration.

Del Mue mined about 15 long tons of ore from a shallow shaft at the northwestern end of the claim and only a short distance up the gulch from the shaft on the Bessie B. claim. A small open cut near the collar of the shaft yielded about 50 long tons of ore from another ore body. A cut farther up the gulch also yielded about 50 long tons of ore. A little farther up the gulch Del Mue sank an inclined shaft 40 feet deep (now filled), but was able to recover only about 5 tons of ore from the ore stringer he followed. Near the collar of this shaft, however, an open cut yielded one chromite pod containing 10 tons of ore and another pod containing 20 tons. He ran a short drift into the heading of this cut and assertedly opened a face of ore 6 feet wide and 4 feet high in another ore body. Although this ore was not mined out, it was not visible in 1949, as the drift had caved. Farther up the gulch from these workings is an

old cut made by the Cox Bros. for Turner and Geisendorfer during World War I. Del Mue estimates that as much as 500 tons of ore may have been taken from this old cut. South of the Cox cut is another deposit that was opened by H. T. Powers during World War I and prospected by L. J. Dunn during World War II. The amount of ore taken from this last deposit is not known.

The various deposits on the Daisy Bell claim apparently have yielded a total of 600 to 700 tons of ore, and ore is known to remain in at least one of the ore bodies that have been found thus far. Nearly all of the mining has been confined to the upper, weathered parts of the ore zones. Additional systematic exploration along the ore zones at greater depths might well result in the discovery of a number of ore bodies similar to those already mined. (Rynearson 49)

Maralls' CAPCO Leases (53a, 53b, 54a)

V. S. and H. R. Marall leased each of the quarters of the NE¼ sec. 31, T. 15 N., R. 11 E., from the Capital Co. at various times during 1944-45. T. C. Green also leased the same areas, but at different times, during 1943-45. The information at hand does not permit positive identification of the specific deposits worked by each lessee. An analysis of data obtained from the records of the Metals Reserve Co. and the Capital Co. indicates that the Maralls mined ore from at least three different deposits. When the writer visited the area in 1950 he saw only three deposits that might have been worked by these lessees. Although one or two other deposits may have escaped detection, it is assumed that each of the deposits seen was worked by both lessees at different times.

Table 8. Chromite production from the Maralls' CAPCO leases, 1944-45

Group	Long tons	Percent Cr_2O_3	Percent Fe	Cr/Fe	Source
	20.6	57.20	11.28	3.47	NE¼NE¼ sec. 31
1	15.8	58.34	11.67	3.42	Do.
	10.5	48.71	11.49	2.90	Do.
	37.3	54.97	13.01	2.89	SE¼NE¼ sec. 31
2	22.2	53.31	13.12	2.78	Do.
	12.0	55.61	11.49	3.31	Do.
3	26.7	50.94	13.05	2.67	SW¼NE¼ sec. 31
	26.2	51.05	13.54	2.58	Do.
Total	171.3				

The workings at two of the deposits visited (53a, 53b) consisted of bulldozer cuts and hand pits in deep residual soil. No ore could be found in place, but a few pieces were seen in the soil scraped by the bulldozer. Evidently the ore mined from these deposits occurred as float and/or residual ore bodies in the residual soil. If either of these deposits was worked during World War I, all evidence of the old workings has been destroyed. The third deposit (54a), however, probably was one of those included in the Sugar Pine mine during World War I. The workings at this deposit comprise two shafts inclined southward, a large bulldozer cut in the deep red and yellow soil around the shafts, and several hand pits, all above the access road, and another inclined shaft in the bottom

of the gully below the road. No ore can be seen in place in the surface workings, which do not penetrate the thick mantle of soil, and the underground workings are inaccessible. The upper shafts, at least, followed ore downward into bedrock, as pieces of dunite on the dumps contain small stringers of massive chromite and some disseminated chromite. It is not known if any ore remained in the underground workings when they were abandoned. (See also Sugar Pine mine.)

The data shown in table 8 indicate the amount, grade and reported source of the ore shipped by the Maralls from deposits on their CAPCO leases. The data are presented in detail mainly to illustrate the variations in the grade of chromite ores from different deposits in a relatively small area. Note the unusually high chromic-oxide content of two lots in group 1. The lots in groups 1 and 2 were shipped in 1944 and those in group 3 were shipped in 1945. (Rynearson 50)

Green's CAPCO (48, 49, 52-54)

Thad C. Green leased various quarter-quarter parts of secs. 29, 31, and 32, T. 15 N., R. 11 E., from the Capital Co. during 1943-45. He produced ore from deposits in the $SE\frac{1}{4}SE\frac{1}{4}$ sec. 29, the $W\frac{1}{2}NE\frac{1}{4}$ sec. 31, and the $NE\frac{1}{4}NE\frac{1}{4}$ and $SW\frac{1}{4}NW\frac{1}{4}$ sec. 32. He may have mined some ore in the $SE\frac{1}{4}NE\frac{1}{4}$ sec. 31 also. It is assumed that he worked at least one or two of the deposits worked by V. S. and H. R. Marall in sec. 31 (see Marall's CAPCO leases). No information is available as to the nature or extent of his workings or to the character of the ore bodies he mined on the leases in secs. 29 and 32.

The workings in the $SW\frac{1}{4}NE\frac{1}{4}$ sec. 31 yielded 20 long tons of ore in 1943 and 66.5 tons plus a few tons of a mixed lot in 1944. Several lots of this ore, aggregating 81.1 long tons, averaged 50.16 percent Cr_2O_3 and 13.26 percent Fe with a Cr to Fe ratio of 2.59. The workings in the $NW\frac{1}{4}NE\frac{1}{4}$ sec. 31 yielded 10.6 long tons of ore plus part of a mixed lot of 16.9 long tons in 1944. Those in the $SE\frac{1}{4}SE\frac{1}{4}$ sec. 29 (may be same as Yellow Pit?) yielded 21.9 long tons of ore plus part of a mixed lot of 16.9 long tons in 1944. One lot of 16.6 long tons of this ore contained 41.97 percent Cr_2O_3 and 10.09 percent Fe with a Cr to Fe ratio of 2.85. The workings in the $SW\frac{1}{4}NW\frac{1}{4}$ sec. 32 yielded about 58 long tons of ore plus part of a mixed lot of 30.6 long tons in 1944. In 1945 those in $NE\frac{1}{4}NE\frac{1}{4}$ sec. 32 yielded 25.8 long tons of ore containing 48.85 percent Cr_2O_3 and 12.55 percent Fe with a Cr to Fe ratio of 2.66. Green's shipments from deposits on lands leased from the Capital Co. total 251 long tons. (Rynearson 50)

Sunset Mine (54b, 55)

The Sunset mine property comprises about 20 acres of patented land, the $N\frac{1}{2}SE\frac{1}{4}NW\frac{1}{4}$ sec. 31, T. 15 N., R. 11 E. Chromite deposits on the property were first worked in the early eighties (by a Mr. Braden?). During World War I the property was considered a part of the Sugar Pine Chrome mine and was operated mainly by Ed Turnbull and Ed Powell. Joseph Del Mue mined some of the ore on a contract basis in 1918; Turner and Geisendorfer and H. T. Powers are supposed to have mined some ore also. Del Mue owned and operated the property in 1941, but sold out to C. L. Mathews, who carried on the mining operations during 1942-43. V. S. and H. R. Marall produced some ore from the

property in 1944, as did T. C. Green in 1945. The property has been idle since 1945.

The workings consist of several pits and bulldozer trenches above, or east of, the Forest Hill-Iowa Hill road and several pits, trenches, and open cuts and four or five shafts below the road. The deepest shaft bottoms at about 42 feet. All these workings were partly filled with waste or water when the writer visited the property early in 1943 and again in the summer of 1950.

Some experimental concentrating equipment was assembled on the property late in 1942 in the hope that it could be used to recover fragments of chromite from the dumps and also from the soil in the vicinity of the workings. It it doubtful that more than a few tons of concentrate was made, because water was available only during the rainy season and even then the supply was limited.

Although numerous workings have been made to exploit the deposits, the geologic features are not readily apparent because critical areas are obscured by soil, water, or mining debris. Therefore, a detailed and integrated geologic description of the deposits cannot be made, but the following statements include most of the relevant information that is available. The northern group of shafts are spaced about 60 feet apart in an open cut or stope opening about 150 feet long. These workings were made to mine a series of ore bodies localized along a zone that trends about N. 55° W. The pits and trenches on both sides of the road lie approximately astride a line projected southeastward along the trend of this zone. The two southern shafts are about 25 feet apart in an open cut or stope opening about 50 feet long. These southern workings are about 150 feet south of the northern cut and appear to be on another ore zone striking almost due north toward the center of the northern cut. Except for a few pieces of float, no ore can be seen in or around the surface workings. However, information supplied by Mathews and Del Mue indicates that the ore occurred as small pods and lenses in small bodies of dunite in the serpentinized saxonite country rock and as float eroded from similar bodies. The largest pod mined by Mathews contained about 40 long tons of ore, and the smallest contained only 1 or 2 tons. The main bulk of the ore bodies mined has consisted of massive chromite, but the margins consisted of streaks and stringers of chromite and some disseminated chromite. The serpentine adjacent to the ore was sheared, but it adhered to the ore and had to be cobbed away. The ore shipped during World War II averaged about 54 percent Cr_2O_3 and had a Cr to Fe ratio of about 2.99; some of the best ore shipped contained as much as 56 percent Cr_2O_3.

No accurate and complete records of the production prior to 1941 exist. Some of Waring's descriptions, which are quoted under the heading of Sugar Pine Chrome mine, give some indication of the magnitude of the early production, and estimates furnished by Del Mue seem to substantiate Waring's figures. Del Mue recalls that he mined about 60 tons of ore from one of the northern shafts and about 9 tons from a cut near this shaft; that Turnbull and Powell mined about 25 tons from another of the northern shafts; and that various operators, including H. T. Powers and Turner and Geisendorfer, mined about 50 tons of ore from the pits at the east end of the property. Thus, the early production probably amounted to at least 150 tons of ore, and may have been twice as much. (See also Sugar Pine Chrome mine.)

Del Mue mined about 12 tons of ore from another shaft (the northernmost shaft in the southern cut?) and about 10 tons from the third pit east of the road in 1941; R. N. Knudsen shipped this ore. Mathews shipped 181.8 long tons of ore in 1942 and 14.3 tons in 1943, most of which came from the southernmost shaft. The Maralls shipped 23.3 long tons of ore (float?) from the property in 1944 and T. C. Green shipped 19.7 tons in 1945, but the specific workings from which they obtained their ore are not known. The production during World War II totals 261 long tons, and the all-time production probably amounts to at least 400 or 500 tons.

About 3 tons of ore, mostly float, is piled near the remains of the concentrating equipment, but no ore can be seen in the surface workings and, according to Mathews and Del Mue, very little ore was left in the underground workings. Most of the float ore on the property seems to have been recovered. It seems, therefore, that the possibility of any future production will depend on the success of exploration for other ore bodies that may occur in the unexplored ground between and adjacent to the mined-out workings. (Rynearson 43, 50; Waring 17)

Kidder Pit (56)

The Kidder Pit is a large irregular open cut on a chromite deposit east of and about 50 feet above the Forest Hill-Iowa Hill road in the southeast corner of the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 31, T. 15 N., R. 11 E., on property owned by the Capital Co. The deposit was opened during World War I, but it is not known by whom. Several operators, including W. C. Crittenden, H. A. Smith and Bruce McCollum, Weiler and Del Mue, and T. C. Green, held leases on the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 31 at various times during 1941-45, but apparently none of them mined any ore from the Kidder Pit. Del Mue thinks that about 75 tons of ore was mined from the deposit prior to World War II. The open cut has sloughed and no ore could be seen in place in 1949, but the dumps may contain a few tons of fragmental chromite, and many small pieces of float ore are scattered on the hillside for several hundred feet below the deposit. (Rynearson 49)

Hewes and Jones Claims

W. I. Hewes and O. H. Jones mined chromite from several claims in secs. 5 and 8, T. 14 N., R. 11 E., during World War I. Although the specific locations of the deposits they mined cannot be given with certainty, some may be represented by locality numbers 59, 61, 62 and 63 on plate 14. Three pits about 12 feet deep on the New Hope claim yielded 60 to 70 tons of very high grade ore in 1918. One carload lot of this ore contained 56.3 percent Cr_2O_3, and some of the ore assayed as high as 60 percent Cr_2O_3. The Pitt deposit yielded some ore in the eighties and 5 or 6 tons in 1918. The Hazel and Snow claims each yielded about 10 tons of float ore in 1918. Apparently no ore has been mined from any of these deposits since 1918. (Cameron 18; Louderback 18)

Southern Pacific Property (64, 65)

The Southern Pacific Land Co. leased the $NW\frac{1}{4}$ sec. 9, T. 14 N., R. 11 E., to G. A. Muller and M. T. Mathews in 1941. Muller mined some ore from one deposit on the property in 1941 and assigned the lease to R. Fitzgerald and R. Russel in 1942. Fitzgerald and Russel also leased the $NW\frac{1}{4}$ sec. 5 from the Mayflower Gravel Mining Co. and the $N\frac{1}{2}$ $SE\frac{1}{4}$ sec.

5, T. 14 N., R. 11 E., from C. L. Finning et al., but confined their mining activities mainly to the deposits in sec. 9. Henry Kirchmann held the $NE\frac{1}{4}$ sec. 9 under lease during parts of 1943 and 1944 and mined a few tons of ore. The deposits in sec. 9 also were worked during World War I, and may represent the Gore, Bell, and King deposits of G. H. Garrison.

The early workings on the deposits in sec. 9 consisted of one shaft and several trenches in the $NE\frac{1}{4}NW\frac{1}{4}$ and two parallel series of shallow pits and trenches extending northward from the $N\frac{1}{2}SW\frac{1}{4}NW\frac{1}{4}$ into the $NW\frac{1}{4}NW\frac{1}{4}$. It is reported that about 125 long tons of ore was shipped from these workings during 1917-18, and it is likely that a large part of this ore consisted of float picked up on the surface or dug out of the red soil.

One of the old pits in the $N\frac{1}{2}SW\frac{1}{4}NW\frac{1}{4}$ still had some ore in the bottom when Muller leased the property. He enlarged the pit until it was about 30 feet long, 20 feet wide, and 18 feet deep and took out about 33 long tons of ore. This ore and about 5 tons of ore from the Lucky Hunter claim was shipped to Tacoma, Washington, but was rejected because the Cr to Fe ratio of 1.84 was too low to meet the prevailing specifications. Averill (41) reported that a small amount of ore remained in the bottom of the pit and about 5 tons was piled on the dump when Muller assigned the lease.

The old shaft in the $NE\frac{1}{4}NW\frac{1}{4}$ was about 10 feet deep with ore about 2 feet wide exposed in the bottom when Fitzgerald and Russel started mining in 1942. They deepened the shaft to about 25 feet and made a stope about 25 feet long and 6 feet wide while taking out 11.7 long tons of ore containing 38.75 percent Cr_2O_3 with a Cr to Fe ratio of 2.27. Kirchmann supposedly mined 4.3 long tons of ore from this same ore body in 1943. His ore contained 39.41 percent Cr_2O_3 and had a Cr to Fe ratio of 2.48. A little ore probably remained in the bottom of the stope when Kirchmann terminated his lease.

The Humphreys Gold Corp. took about 100 auger samples of the soil in the areas between the two groups of workings on the property. Evidently these samples contained very little chromite, as no attempts were made to work the soil for its chromite content. (Southern Pacific Land Co. 49; Brown 42; Averill 41; Hayes 25)

Schermeir Prospect (66)

A small chromite deposit back of Wm. Hoffman's house on the east edge of sec. 21, T. 14 N., R. 11 E., yielded about 3 tons of ore in 1918. Herman Schermeir mined the ore from a small pit in sheared talcose serpentine, but the ore was not disposed of until World War II, when it was purchased and shipped by L. G. Embree. Although a few very small stringers of chromite remain in the pit, the deposit does not warrant further prospecting. (Rynearson 50; Bradley 18; Waring 17)

Bunker Mine (67-69) [40]

The Bunker mine includes the deposits on several claims in the $S\frac{1}{2}SE\frac{1}{4}$ and $SE\frac{1}{4}SW\frac{1}{4}$ sec. 20, T. 14 N., R. 11 E. These deposits were among the first to be expolited in Placer County, having been worked by Frank Hoffman in the early eighties when, for a few years, the ore was in demand for use in the furnaces of an iron smelter. The ore mined during this early period was stockpiled on the top of the ridge near the Michigan Bluff-Forest Hill road, where supply wagons returning from Michigan

Bluff could pick up small lots for a pay road on their return trip. Some ore (about 75 tons?) remaining in the stockpile was claimed and sold by a man named Ed Hill during World War I. The property was known as the Blue Bird mine in 1917-18 when it was owned by H. H. Bunker and operated by the Union Chrome Co. In later years the property became known as the Bunker mine and Herman Schermeir acquired the title to the Bunker claims. He leased the Bunker No. 1 and No. 2 claims to L. G. Embree, who worked the deposits during 1942-43. Embree also located and prospected the Coal Pit, Bay Tree, and Sunnyside claims nearby.

The writer made a brief examination of the principal workings of the mine with Wm. Hoffman in 1950, but none of the underground workings were accessible and the surface workings had sloughed so much that very little detailed information could be obtained at that time. However, previous reports by Waring (17), Averill (42), and Dow (43) include descriptions of some of the deposits and workings, and an attempt has been made to incorporate their descriptions in the statements that follow.

At least 10, and perhaps more, occurrences of chromite have been mined or prospected on the property. The ore occurs as lenses, pods, and small stringers of both massive and disseminated chromite in small bodies of altered dunite. The ore bodies and the enclosing dunite masses appear to be localized along more or less definite zones that trend from N. 60° to 90° W. Perhaps four such zones contain the deposits on the Bunker claims.

On the south edge of the Bunker No. 1 claim, several hundred feet east and north of Embree's cabin, is an old pit dug entirely in dunite. The pit is about 25 feet in diameter and 10 feet deep, but waste in the bottom may conceal a shallow shaft, as the amount of material on the dump appears to be greater than that which could have been taken from the present opening. Neither the amount nor the character of the ore mined from this deposit is known. Some disseminated ore on the dump probably represents low-grade material sorted from the ore that was shipped.

The main workings of the mine are along an ore zone a few hundred feet northeast of the pit described above. This ore zone has been traced by workings from the bottom of a gulch westward up the hillside for about 400 feet. A narrow, shallow open cut about 200 feet long was made along the central part of the zone in the early eighties. About 100 feet west of the cut is an irregular open cut with a shaft in the bottom and a drift extending westward from the west end; these were made during World War I. The shaft either is filled or is covered over, but the remains of the whim used to hoist from the shaft can be seen on the south edge of the cut. Apparently this shaft is the one that previous reports describe as being 80 to 85 feet deep. Dow was informed that it was sunk in ore 2 feet wide. The entrance to the drift is also covered, but the drift seems to be the one that Waring was referring to when he wrote the following:

> ". . . a 50′ tunnel had exposed an ore body 40′ long striking east-west. The body pinches out in the face of the tunnel, but is exposed 30″ wide for a distance of 30′ along both the floor and roof of the tunnel. About 100 tons of 45% ore were piled and there was at least 65 tons in sight to be mined."

At the east end of the old cut is a shaft sunk by Embree in 1942-43. This shaft, which may be about 50 feet deep, is flooded below the 20-foot level. According to Dow, the shaft was started on a stringer of ore about 18 inches wide, which led to a pod of ore 6 feet wide at a depth of 15 feet. Embree followed this pod to a depth of 30 feet and then ran a short drift westward along the strike of the ore. According to Hoffman, Embree did not extend his workings to the limits of the ore body because most of the ore in the lower levels was almost too low in grade to ship. Most of the 132 long tons of ore produced by Embree came from these underground workings.

Waring described two other tunnels, one 10 feet higher than the other, but the openings to these evidently have been covered. The openings probably were located in the old cut at or just west of the collar of Embree's shaft. Waring reported that the upper tunnel was 64 feet long and it exposed ore 18 inches wide for 12 feet along the roof (near the portal?); approximately 60 tons of ore containing about 40 percent Cr_2O_3 had been mined from the tunnel and 10 tons more was in sight. The lower tunnel had been driven along the same ore body for 10 feet in ore that was 4 feet wide; 35 tons of this ore was in sight. No information is available as to the ultimate extent of these workings or the total amount of ore mined from them.

Although the ore zone along which the main workings lie may contain appreciable reserves of ore in those ore bodies that already have been worked, as well as in other undiscovered bodies, it is likely that the bulk of the ore contains less than 35 to 40 percent Cr_2O_3. Essentially, the ore is of a disseminated type, with a wide range in chromite content. The average ore probably contains only 30 to 35 percent Cr_2O_3. Some parts of the ore bodies, however, contain irregular stringers of coarse-grained, nearly massive chromite, and these parts, along with parts in which the percentage of disseminated chromite is high, have constituted the ore that has been shipped in the past. Several hundred tons of the lower-grade, rejected ore remains on the dumps. One lot of 24 long tons of ore shipped by Embree contained 45.20 percent Cr_2O_3 and 12.20 percent Fe with a Cr to Fe ratio of 2.53. However, his total production averaged only 40.64 percent Cr_2O_3 and 12.23 percent Fe with a Cr to Fe ratio of 2.27. A unique feature of the ore in this zone is that the matrix of the chromite consists largely of uvarovite, which has a relatively high specific gravity. Consequently, attempts to concentrate the low-grade ore by gravity methods might not be successful.

Another ore zone a few hundred feet to the north and somewhat west of the upper shaft of the main workings has been opened by several shallow open cuts and pits and two shafts. The most important of these are located near the top of the ridge on the edge of Coal Pit Flat. During World War I a shaft was sunk on an ore body in the slickentite of a shear zone striking about N. 60° W. This shaft probably is the one that Waring described as being 50 feet deep in 1917. According to him, the shaft was sunk on an ore body pitching 70° SE., and a 2-foot width of ore was exposed along the northwest wall of the shaft and along the lower 30 feet of the southeast wall. About 60 tons of ore had been mined and 30 tons of unmined ore was in sight. Later reports by Averill and Dow indicate that this shaft may have been sunk to a depth of 90 feet before it was abandoned. Embree sunk another shaft 20 to 25 feet deep on the shear zone

about 15 feet northwest of the old shaft, but he found only about 5 tons of ore.

Some ore was mined during World War I from workings at the wye of the roads on the Coal Pit claim in the $SE\frac{1}{4}SW\frac{1}{4}$ sec. 20. One old shaft has been covered up and an inclined shaft or drift is partly caved and was inaccessible in 1950. Embree did a little work in these old workings but did not find enough ore to make a shipment. A thick mantle of residual soil covers the area and obscures the geology of the deposit. Although a few pieces of soft, altered dunite on the dump near the pit contain only small stringers of massive chromite and a little disseminated chromite, it is likely that some larger masses of massive chromite contributed the ore that was shipped.

A few other small pits are scattered over the property. Some of these have opened small lenses or narrow stringers of ore in place and some have been made on occurrences of abundant float. Several of these prospects warrant further exploration, as do the two principal ore zones. Although much massive chromite float is scattered over the hillside area between the two principal ore zones, the area has not been thoroughly prospected. Reserves of the deposits might well be equal to or even greater than the amount of ore already produced.

The total production of the Bunker mine is not known with certainty. One estimate of 3,000 tons has been made, but this figure seems much too high. The production during the early eighties probably did not amount to more than a few hundred tons. Records of the California Division of Mines indicate a production of 570 long tons of ore by the Union Chrome Co. in 1917, and records of the U. S. Geological Survey credit Bunker with a production of 132 long tons in 1918. Embree shipped 129 long tons of ore in 1942-43. Therefore, the total production of the mine is probably 1,000 to 1,500 long tons of ore. (Rynearson 50; Dow 43; Averill 42; Bradley 18; Cameron 18; Louderback 18; Waring 17)

Washout Claim (71)

The Washout chromite deposit is located near the line between the $NE\frac{1}{4}$ and $NW\frac{1}{4}$ sec. 30, T. 14 N., R. 11 E., about a quarter of a mile north of the Paragon gold mine. G. S. Ford, J. S. Lower, and B. Myers owned and operated the property from 1940 to 1944. The deposit was discovered in 1940, when a ditch carrying water for hydraulic mining overflowed and the errant stream washed away the soil covering a lens of ore at the surface of the bedrock. Early in 1943 the workings comprised a large open cut, a crosscut beneath the original outcrop, and a shaft 25 feet deep. At that time, while water was available, the operators were recovering some of the chromite from the dumps and from the soft disseminated ore by washing the material through a series of sluice boxes. It is believed that subsequent operations were restricted mainly to additional mining in the shaft.

The ore occurred as irregular bodies containing disseminated chromite and as lenses and stringers of massive chromite along a zone about 125 feet long. This zone had a strike of N. 40° W. and a dip that varied from 60° SE. to vertical. The largest lens of massive ore found in the deposit contained about 50 long tons of ore.

The deposit is credited with shipments of 206 long tons of ore in 1941, 63.8 tons in 1942, 156.4 tons in 1943, and 10.6 tons in 1944. This ore averaged 47.29 percent Cr_2O_3 and had a Cr to Fe ratio of about 2.51. In addi-

tion to the ore shipments given above, about 30 long tons of ore mined in 1942 was used to "sweeten" ore from deposits in Humboldt and Siskiyou Counties. Therefore, the total production amounts to approximately 470 long tons. (Rynearson 43; Averill 41, 43)

Lehigh Canyon Patent (72, 73)

F. R. Bowers, in partnership with E. W. Drummond and M. D. House, worked two small chromite deposits in 1918 in sec. 30, T. 14 N., R. 11 E., on the Lehigh Canyon Patent property. One deposit was at or near the Poco Tiempo Quartz mine (73) in the $SW\frac{1}{4}$ sec. 30. Bowers and Drummond made several short adits and small open cuts or pits in this deposit and mined approximately 35 tons of ore containing about 40 percent Cr_2O_3. The other deposit was in the $NE\frac{1}{4}$ sec. 30 and was called Buttercup Chrome (72). Nothing is known about the nature or extent of the workings made to exploit this deposit, but Bowers and House mined at least 55 tons of ore containing about 43 percent Cr_2O_3, and they may have produced as much as 150 tons of ore from the deposit. No ore has been mined from either deposit since 1918. (Cameron 18; Louderback 18)

Spanish Mines Consolidated (74)

E. A. Garrison mined chromite during World War I from pits on the Spanish and Esmeralda claims of the Spanish Mines Consolidated gold property in the southeast corner of sec. 25, T. 14 N., R. 10 E. Records of the U. S. Geological Survey credit Garrison with shipments of 46 tons of ore in 1917 and 36 tons in 1918 and with 18 tons stocked at the end of 1918. No ore has been produced from the deposits since 1918. (Bradley 18; Louderback 18; Waring 17)

Little Greek Claim (77)

L. G. Embree located the Little Greek claim in 1942 on a small chromite deposit in the northeast corner of sec. 31, T. 14 N., R. 11 E. An unidentified operator reportedly mined and shipped two carloads of ore during World War I from a shaft sunk 25 feet through soil and weathered rock. Embree sank one shaft 15 feet deep and another 12 feet deep with a drift extending 12 feet from the bottom. The shafts were flooded when Dow visited the property early in 1943, and the only ore he saw was some disseminated chromite in weathered dunite on the dump. On the basis of information given by Embree, Dow concluded that the ore occurred along a vertical zone striking about N. 70° W. Embree did not ship any ore from the deposit. (Dow 43)

Black Rock Chrome (79)

R. F. Craig and Orin H. Jones opened two chromite deposits during World War I on the Black Rock Chrome property in the southwest corner of sec. 36, T. 14 N., R. 10 E., and the northwest corner of sec. 6, T. 13 N., R. 11 E. Their workings consisted of one pit 12 feet deep and another pit 25 feet deep. Nothing is known about the geology of these deposits. According to Louderback (18), the deposits yielded 32 tons of ore in 1917 and 85 tons in 1918. This ore contained from 45 to 52 percent Cr_2O_3. (Cameron 18; Louderback 18)

Colfax-New England Mills Area

Black Streak Claim (81)

Willis D. Parker and William N. Kelley located the Black Streak chromite claim in 1942 in the $N\frac{1}{2}NE\frac{1}{4}SE\frac{1}{4}$ sec. 2, T. 14 N., R. 9 E. They

apparently could not find a minable ore body, as no ore was shipped from the claim. (Gros 42)

Bugg (82)

Chares E. Bugg reported a production of 67 long tons of ore in 1916 from a deposit near Weimar. Bryner's report lists the Bugg deposit as being in sec. 21, T. 14 N., R. 9 E. Bugg reportedly mined 8 long tons of ore in 1918 from the Fred Meyer property, also near Weimar. No other information is available concerning these deposits. (Bryner 40; Bradley 18)

Major Prospect (82)

W. B. Swares and W. B. DuBois held a lease in 1918 on 40 acres of patented land owned by E. N. Major in the eastern part of sec. 21, T. 14 N., R. 9 E. The lessees found float on the property, but their efforts to locate the source of the float apparently were not successful, as no shipments of ore have been credited to them. (Cameron 18)

Hepburn (83)

About one ton of chromite was taken in 1918 from the topsoil on the property of G. C. Hepburn in the $SW\frac{1}{4}SE\frac{1}{4}$(?) sec. 5, T. 13 N., R. 9 E. One small pit and several trenches failed to uncover additional ore. (Cameron 18)

Gas Canyon Area

Farmer Property (84-88)

R. H. Farmer and J. G. Dodds of the Placer Chrome Co. purchased or leased the mining rights to 415 acres of land in secs. 12, 13, 18, and 24, T. 13 N., R. 9 E., during the latter part of 1918. His holdings included all the deposits that had been found in the Gas Canyon area. These deposits are described separately below. All were small, and Farmer apparently could not develop any large reserves of ore, as the information concerning his operations in the area is sketchy. Although the Placer Chrome Co. estimated that about 500 long tons of its total 1918 production came from Placer County, it is doubtful that more than 50 or 100 tons of this ore came from the Gas Canyon area. Probably most of the company's Placer County ore was purchased from other operators in the county. (Louderback 18; Cameron 18)

Dodds Ranch Prospect (84)

A small open cut was made in 1917 on a chromite prospect six or seven hundred feet southeast of the house of J. G. Dodds near the center of sec. 12, T. 13 N., R. 9 E. A little low-grade ore containing 20.4 percent Cr_2O_3 and 18.0 percent SiO_2 was found, but, so far as is known, none of the ore was rich enough to ship. (Waring 17)

Green (Americus) (85)

The Green, or Americus, deposit in the $SE\frac{1}{4}$ sec. 12, T. 13 N., R. 9 E., was leased by Guy Walsh and a Mr. Hall of Auburn during 1917 and part of 1918 from J. G. Dodds et al. R. H. Farmer leased the property during the later part of 1918. Walsh and Hall made a shaft 24 feet deep with 12 feet of short drifts at the bottom. The ore occurred as a series of small lenses striking about N. 35° W. No ore was exposed in the workings when Waring visited the deposit in 1917, but some containing 21.1 percent Cr_2O_3 and 12.0 percent SiO_2 had been mixed and shipped

with ore from the Gas Canyon claim. The total amount of such ore yielded by the deposit is not known. (Logan 27; Bradley 18; Waring 17)

Gas Canyon Claim (86)

Walsh and Hall worked a chromite deposit on the Gas Canyon claim in the $E\frac{1}{2}NW\frac{1}{4}$ sec. 13, T. 13 N., R. 9 E., during 1917 and possibly 1918. R. H. Farmer also may have mined some ore from this claim in 1918. Walsh and Hall mined a nearly vertical, chimneylike ore body from a shaft that was 10 feet deep when Waring visited the claim. At the 10-foot level in the shaft the ore body had a cross section measuring 4 feet by 6 feet, with the longer axis of the section oriented almost due east. A little uvarovite was present in the ore. Walsh and Hall produced between 50 and 100 long tons of ore from deposits in the Gas Canyon area, and most of this ore came from the Gas Canyon claim. A carload shipment of mixed ore from the Gas Canyon and Green deposits averaged about 34 percent Cr_2O_3. (Logan 27; Bradley 18; Waring 17)

Fiddler's Green (88)

Walsh and Hall also opened two small chromite deposits on the Fiddler's Green property, which they leased in 1917. R. H. Farmer acquired their interests in the property in 1918. Waring reported the location of the deposits as sec. 29, T. 13 N., R. 9 E., but the writer believes that the section number was erroneously recorded and should be 24 instead of 29.

The workings on the original discovery consisted of four open cuts about 10 feet long and 4 feet deep and a shaft 12 feet deep. These workings opened a series of small "bunches" of ore striking N. 80° E. along the contact between the serpentine and amphibolite schist. Waring reported that the ore was fine-grained and contained magnetite. One assay showed that the ore contained 32.3 percent Cr_2O_3 and 13.0 percent SiO_2. About 5 tons of similar ore was on the dump in June 1917.

At the other deposit, which was about 50 feet lower in altitude than the original discovery, a shallow open cut about 30 feet long exposed a stringer of low-grade ore (disseminated ore?) striking N. 60° E. and dipping 60° SE. About 4 tons of the ore was on the dump at the time of Waring's visit. It is not known if any of the ore from either deposit was shipped. (Logan 27; Bradley 18; Waring 17)

Dry Creek Area

Parker Ranch (89) [42]

The Parker Ranch chromite deposit, also known as the Meadowbrook Ranch, McNear, or Auburn Chrome mine, is located in the $S\frac{1}{2}NE\frac{1}{4}$ sec. 17, T. 13 N., R. 8 E., about half a mile east of Highway 49. The deposit, first discovered in 1917, was worked in 1918 and again in 1943-44. Ivan H. Parker owned the property in 1918 and leased to F. W. McNear, who developed the mine and operated a small mill to concentrate the ore. Chester C. Butler and John C. Wold obtained a lease from Herman Oest, the present owner, and reopened the old workings in 1943 with the aid of a development loan from the Reconstruction Finance Corp. Butler and Wold made a few tons of concentrate in a small mill about 3 miles from the mine, but were forced to abandon their operations early in 1944, ostensibly because they lacked an adequate supply of water to run the mill.

The workings made by McNear consisted of an access tunnel about 140 feet long leading to two interconnected open stopes or glory holes, a shaft 31 feet deep into the floor of the larger glory hole, two short crosscuts and a short drift from near the bottom of the shaft, two open cuts, and three small trenches (see fig. 4). An early report by Taliaferro mentions three shafts. One of these undoubtedly was the shaft described above, and the other two probably represented early development work at the sites of the glory holes. Butler and Wold cleaned out the access tunnel and the caved areas in and between the glory holes, pumped out the shaft, and cleaned out parts of the three sublevel openings.

The deposit consists of a zone of streaks and small lenses of disseminated ore occurring in a small mass of serpentine near the contact with a mass of diabase(?). Although but little ore is exposed in the present workings, the information contained in previous reports and the data shown on figure 4 indicate the general features of the deposit. The ore zone strikes north with an over-all dip of about 80° E., but locally the dip is more moderate. Cameron was told that the ore zone was 40 feet wide in the large glory hole, but this figure probably represents a maximum width as the average width does not seem to be more than about 20 feet. The average depth of the zone appears to be about 50 feet. Figure 4 shows the strike length of the zone to be approximately 150 feet. The chromite in the ore is fine-grained and, although Taliaferro noted the lack of marked banding in the ore, the tenor evidently ranges widely, as the ore that was milled averaged about 8 percent Cr_2O_3 and small amounts of ore containing about 40 percent Cr_2O_3 was sorted from the lower-grade material and shipped as lump ore.

McNear reported to the State that he shipped 448 tons of ore in 1918, including the ore he mined from the nearby Black Arrow Ranch. However, judging from the amount of royalty Mr. Parker says he received, the actual amount shipped must have been much larger. The ore shipped by McNear contained 39 to 40 percent Cr_2O_3 and the major part consisted of concentrate made from the Parker Ranch ore. Butler and Wold milled 30 tons of low-grade ore and made 5 long tons of concentrate containing 43.93 percent Cr_2O_3 and 19.70 percent Fe, with a Cr to Fe ratio of 1.53.

When Cameron visited the property in June 1918 he estimated the deposit to contain 21,000 long tons of milling ore and 500 tons of shipping ore. These estimates seem to be rather high, especially for the amount of shipping ore. At least 5,000 long tons of the ore in the original deposit must have been mined and milled to obtain the amount of concentrate produced in 1918. Very little ore remains in the ground above the floor level of the stopes, but Brown's report indicates that considerable ore remains below the floors of the stopes. Assuming that the ore remaining averages 20 feet in width and 25 feet in depth for 100 feet along the strike, about 5,000 long tons of ore containing about 8 percent Cr_2O_3 is inferred. The concentrate made by Butler and Wold contained an exceptionally high percentage of Fe, and this feature, if characteristic of all the ore, will be a serious handicap to future operators. (Rynearson 49; Averill 43; Brown 43; Louderback 18; Cameron 18; Taliaferro, in Louderback 18; Bradley 18.)

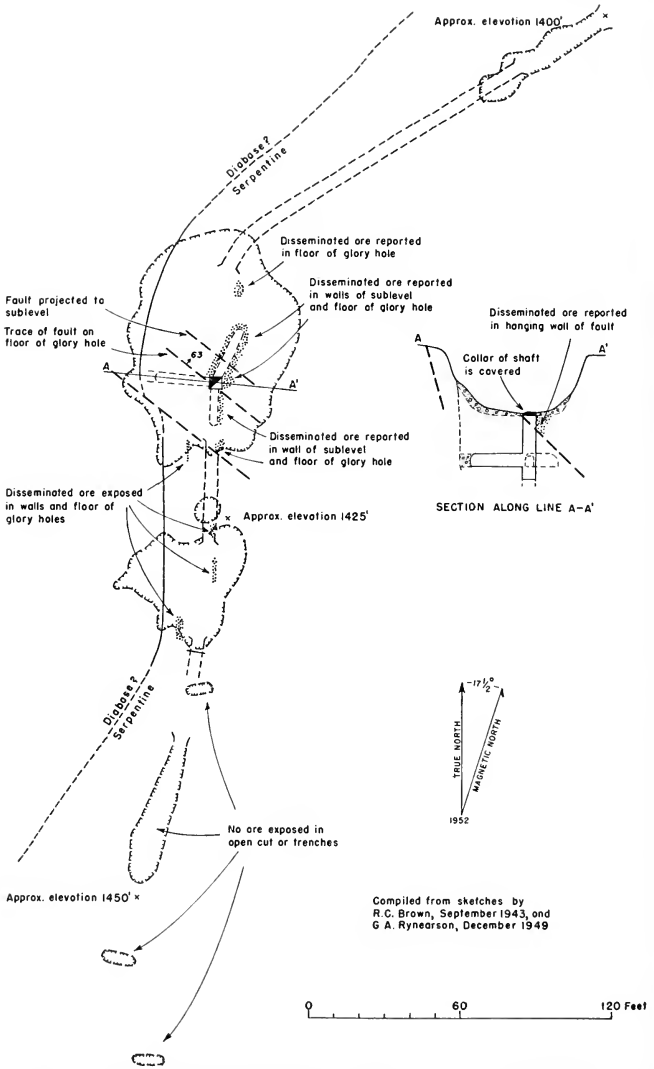

FIGURE 4. Geologic sketch map of the Parker Ranch chromite mine, Placer County

Black Arrow Ranch (90)

The Black Arrow deposit, on the property of the Black Arrow Ranch Co. in sec. 16, T. 13 N., R. 8 E., was leased and operated by F. W. McNear in 1918. The workings made to exploit the deposit consisted of an inclined shaft 50 feet deep and several small open cuts. According to Cameron, the ore occurred as small lenses 6 inches to 3½ feet wide. Taliaferro reported that most of the ore exposed in the workings in May 1918 consisted of "leopard ore" (nodular ore) containing about 40 percent Cr_2O_3, but that some massive ore had been found in the cuts and as float. Some of the blocks of float were as much as 3 feet in diameter. Some of the float ore was gathered up and shipped prior to 1916. According to Louderback, 100 tons of ore had been shipped from the deposit by May 1918 and 40 tons of ore was in sight at that time. Apparently no ore has been shipped from the property since 1918. (Cameron 18; Louderback 18; Taliaferro, in Louderback 18.)

Nevada County

Introduction

Nevada County is a long, narrow land unit occupying 979 square miles between the Middle Fork of the Yuba River and the Bear River (see pl. 12). It extends from the low western foothills of the Sierra Nevada eastward across the summit of the range to the valleys and ridges of the Basin Ranges province along the California-Nevada border. Most of the county's 19,300 inhabitants (1950 census) live in and near the communities of Nevada City and Grass Valley in the western part of the county. Mining, farming, and lumbering are the county's principal industries.

Much of the eastern part of the county is covered by Tertiary and Quaternary volcanic rocks and Quaternary alluvium, lake beds, and glacial deposits, all of which overlie a basement composed largely of granitic rocks. The geology of the west-central part of the county is dominated by a wide belt of the Calaveras formation, which is split by the "great serpentine belt" and partly covered by remnants of the eroded mantle of Tertiary and Quaternary volcanic rocks and stream gravels. The western part is a geologically complex area consisting mainly of basic intrusive and extrusive igneous rocks—equivalent to or slightly later in age than the Mariposa slate—intruded by small masses of ultramafic, gabbroic, and dioritic rocks and large masses of granitic rocks.

The ultramafic rocks of Nevada County all occur in the western half of the county in three belts that correspond to the three belts in Placer County. The western belt is represented mainly by a group of lenticular serpentine masses near the south edge of the county. The structural relation of these masses to each other, to several small unmapped masses to the north and to the northwest, and to other rocks in the area is not readily apparent from the mapping that has been done. The belt as a whole appears to trend north, but the serpentine masses trend northwest. Perhaps the masses occupy northwest-trending structures near their intersection with north-trending structures that controlled the position of the belt as a whole.

The central belt is represented by several small ultramafic masses associated with rocks of the Mariposa slate in the Chicago Park area

Table 9. Chromite production from Nevada County, California (in long tons)

Property	Map No.	1916	1917	1918	1919	1920-49		Total	Total unofficial estimate*
						Year	Tons		
Alta Hill	24			117		1937	60	177	177
Bartholomew-Simms lease	11			[1]					15
Bowden	34				[a](80)				
Codd prospects	22				[a, c](71)				
Davey prospect	26			[1]					3
Dickerson	33			[1]					6
Dorsey and Ridge	32				[a, c](54)				
Eden	18			[1]					5
Geach	30			[c]43				43	43
Gillis prospect	3			[1]					22
Half Chrome	42	[c]49	147					196	196
Holseman (and others)	23	353	154	80	[b]161			748	750
Lucky Bob					[a](13)				
Maguire prospect	12			[1]					5
Merrifield	17			[2]					25
Moscatelli No. 1	5		[c]85	[c]29	[b, c 25]			139	140
Moscatelli No. 2	2		13	11	[b]6	1944	20	50	50
Mulcahy prospect	20			[1]					20
Olsen	10		[c]10		[b, c](10)			20	20
Platz				[1]					5
Porter	19			893	[b]178			1,071	900±
Raab				[1]					5
Rapid Fire	7			[3]				[3]	50+
Red Ledge	8	[c]402	[c]384	230	[b]359	1943	[b]5	1,380	1,265
Rolpholm Ranch	39			[1]					2
Schmidt	37			[1]					3
Sherman Ranch	15			146				146	146
Sleeman	40				[a](11)				
Snyder				[4]					200±
Spring Hill	28		[1]						10
Standard	21			[1]					30
Sweet Ranch	43	82	206	424				712	725+
Thompson Ranch	41			[1]					30±
Tomkin	44					1943	11	11	11
Turtledove Chrome	6		24		[b]9			33	33
Victory	9		[c]66			1942	50	116	120
Waite	16			205	[b]232			437	425
Weisgien	38			[1]					3
Williamson and Cole	1			[3]				[3]	60
Totals		886	1,089	2,178	980		146	5,279	5,500±
Federal totals		881	1,005	2,189	197				
State totals		876	1,752	2,971	107				

* Totaled separately. Estimates based on information obtained from all available sources.
[a] Ore reported stocked at end of previous year, not added because most is below shipping grade.
[b] Ore reported stocked at end of previous year, presumably shipped during year shown.
[c] Amount reported to California Division of Mines.
[1] Some production reported, but amount not specified. May be included in production credited to other properties.
[2] Included in production of Waite property.
[3] Included in production of Red Ledge mine.
[4] Included in production of Porter property.

and by several masses, both large and small, in and north-northwest of the Grass Valley-Nevada City area. The masses in the latter area occur in a structurally and lithologically complex environment that includes many of the pre-Tertiary and some of the post-Tertiary rock types found in the northern Sierra Nevada.

The large ultramafic mass that constitutes the principal member of the "great serpentine belt" in Placer County extends northward across Nevada County along the west side of the major fault that marks the

western margin of the Blue Canyon formation. This mass narrows considerably in the northern part of the county, but the belt as a whole flares out west of the fault to include a wide zone of gabbro and amphibolitic rocks and several small masses of ultramafic rocks.

Chromite deposits have been found and exploited in all three belts. Nearly all the deposits in the eastern belt consist of massive ore of medium to high grade. Most of the deposits in the central and western belts consist of disseminated ore and a few stringers of massive ore. The chromite in most of the deposits in the central and western belts is notably high in iron.

History and Production

Among the chromite-producing counties of California, Nevada County stands thirteenth in amount of ore produced, with a total production of approximately 5,500 long tons. The occurrence of chromite near Nevada City was noted by Trask (53) in the early 1850's but the first mining done was in 1898, when some ore was taken from a deposit on the Sweet Ranch in the Wolf Creek area. However, little interest was taken in the county's deposits until 1916, when production was stimulated by the high wartime market for chromite. Deposits of both massive ore and disseminated ore were worked extensively during 1916-18, and two large stamp mills near Nevada City were utilized to produce several hundred tons of low-grade chromite concentrates from several thousand tons of the low-grade disseminated ores or nearby deposits. Plans to treat similar ores from more distant deposits were abandoned because the ores would not yield concentrates of a high enough quality to justify the long haul to the mills. But little ore has been mined in the county since 1918. Most of the ore sold in 1919 and all of the ore sold in 1937 consisted of stocks left over at the end of 1918. Only 86 long tons of ore was shipped from the four deposits worked during World War II. Detailed production figures for the deposits in the county are given in table 9.

Although more than 40 deposits have been opened in Nevada County, nearly one-fourth of the total chromite production has come from one mine in the eastern belt, and over one-half from four other deposits in the central and western belts. Many of the other deposits yielded only a few tons of ore each. The very small production during World War II indicates that most of the known deposits either are worked out or the ore remaining in them is too low in grade to ship. It would seem, therefore, that the prospects are not bright for any important future production of chromite in the county. Small amounts of shipping-grade ore might be sorted from the low-grade ores in a few deposits in the central and western belts, but it is doubtful that the amount of ore that could be sorted from any one deposit would justify the high cost of such mining. On the other hand, further exploration of the higher-grade deposits in the eastern belt might result in the discovery of other ore bodies holding appreciable amounts of good ore.

Mines and Prospects

Washington Area

Williamson and Cole Claim (1)

The partnership of T. B., R. F., and J. M. Williamson, and C. M. Cole mined chromite from an unidentified claim in the northern part of the Washington area in 1918. References to the location of the claim are

conflicting. The tentative location in sec. 25, T. 18 N., R. 10 E., as shown on plate 13, is based on Cameron's description of the location with respect to the Nevada City-Graniteville road. One ore body on the claim yielded 45 long tons of high-grade ore. In addition, 15 long tons or more of ore was taken from smaller lenses or collected as float. The total amount of ore shipped from these deposits is not known, as the production figures for the several properties operated by the partnership were not reported separately. (Louderback 18; Cameron 18)

Moscatelli No. 2 (2)

During World War I the Moscatelli No. 2 property consisted of the Lucky Friday and Lucky Bluff claims located in sec. 36, T. 18 N., R. 10 E. The property was owned by Peter Moscatelli and H. O. Kohler during 1917-18 and by Robert Moscatelli in 1944. About 13 long tons of ore was mined from an open cut in 1917 and 11 tons from an inclined shaft in 1918. The owners reported they had 6 long tons of ore containing 42.31 percent Cr_2O_3 on hand at the end of 1918, but this ore probably was sold during 1919. Robert Moscatelli shipped 20.4 long tons of ore from the property in 1944. His ore contained 39.21 percent Cr_2O_3 and 10.1 percent Fe and had a Cr to Fe ratio of 2.66. (MacBoyle 19; Bradley 18)

Gillis Prospect (3)

C. A. Gillis, deceased, located a chromite deposit in the NW¼(?) NW¼ sec. 1, T. 17 N., R. 10 E., during World War I. Gillis told the writer that a small lens of high-grade ore projected about 5 feet above the ground level when discovered. He mined 22 long tons of ore from the lens, leaving a small open cut with no ore showing in it, but did not ship the ore. Another person, believed to be Sam Schwartz, removed the ore from the property after the Armistice. According to Gillis, the ore, or at least the sample he took, contained 62 percent Cr_2O_3. This is the highest percentage of Cr_2O_3 recorded for any of the chromite found in the northern Sierra Nevada region, if not in the State. (Rynearson 43)

Flintlock Claim (4)

A single chromite claim, called the Flintlock No. 1, was located on the north side of Poorman Creek in the NW¼ sec. 1, T. 17 N., R. 10 E., by Henry Adams about 1941. Four lenses of disseminated ore were prospected along a zone striking N. 20° W. and dipping, almost vertically, to the southwest. The individual lenses pitched steeply to the northwest. The largest lens was 6 feet wide, 10 feet long, and had been mined to a depth of 4 feet; the smallest was 18 inches wide, 3 feet long, and had been mined to a depth of 2 feet. Gros estimated the ore to contain not more than 35 percent Cr_2O_3, and said only about 10 long tons of such ore was in sight in 1942. No ore was shipped from the deposit. (Gros 42)

Moscatelli No. 1 (5)

During World War I, Robert Moscatelli of Washington owned a chromite claim on the south side of a spur ridge west of Poorman Creek in N½SW¼ sec. 1, T. 17 N., R. 10 E. The Union Chrome Co. leased and worked the deposit in 1917-18. A shaft and several small pits constituted the only workings. Several small lenses and one relatively large lens of ore were found. The large ore body was 8 feet wide in the center and 20 feet long, tapering to a point at either end. The strike of this ore body was N. 15° W. Although samples of the ore from the outcrop assayed 54

percent Cr_2O_3, the ore was diluted with waste in mining and that shipped contained only about 42 percent Cr_2O_3. Production records reported for the deposit do not agree, but they indicate that approximately 85 long tons of ore was mined and shipped in 1917 and that 54 long tons of ore was mined but only 29 tons was shipped in 1918. It is not known if the 25 tons of ore stocked in 1918 was shipped at some later date. (MacBoyle 19; Bradley 18; Louderback 18; Waring 17)

Turtledove Chrome Mine (6)

A chromite deposit known as the Turtledove Chrome mine in 1917-18 was located on the east side of Poorman Creek in the NE¼(?) SW¼ sec. 1, T. 17 N., R. 10 E. Walter Niles, Fred Miller, and H. O. Kohler of Washington owned and operated this property. The main working was on the south side of a spur ridge and consisted of an open cut from 2 to 4 feet wide, 25 feet long, and 4 feet deep. A lens of massive ore with a strike of N. 10° E. was mined from the cut in 1917. On the north side of the spur ridge about 75 feet from the open cut a pit 4 feet wide, 6 feet long, and 5 feet deep was made in prospecting a very thin stringer of chromite. In 1917 the deposit yielded 24 long tons of ore containing about 52 percent Cr_2O_3. Niles made one report stating that 9 long tons of ore had been mined and stocked in 1918 and another report stating that 5 tons had been shipped in that year. The total production, therefore, amounts to about 30 or 35 long tons of ore, most of which came from the ore body mined from the open cut. (MacBoyle 19; Bradley 18; Waring 17)

Rapid Fire Claim (7)

The Rapid Fire claim was located on a chromite deposit in the SW¼ sec. 12, T. 17 N., R. 10 E., by the partnership of T. B., R. F., and J. M. Williamson, and C. M. Cole in 1918. Cameron visited the property a few weeks after mining operations had begun and reported that a small open cut had exposed a lens of ore about 2.5 feet wide and 10 feet long. The production of this deposit probably was included with that of the Red Ledge and other deposits operated by the partnership, as it was not reported separately. However, the reserve estimates given by Cameron and Louderback indicate that the deposit could have yielded as much as 50 and perhaps even 100 long tons of ore. (Louderback 18; Cameron 18)

Red Ledge Mine (8) [32]

The Red Ledge property, consisting of a group of claims covering 150 acres, was developed originally as a gold mine. However, chromite occurs on the Red Ledge and Red Ledge Extension claims in the NW¼NE¼ sec. 13, T. 17 N., R. 10 E., and this deposit has contributed the major part of the chromite produced from the Washington area. T. B., R. F., and J. M. Williamson, and C. M. Cole were the owners when chromite was mined during World War I. T. B. Williamson of Oakland, C. M. Cole of Washington, and E. A. Langford of San Rafael were the owners in 1949. The principal chromite mining operations were carried on from 1916 to 1918, and the workings made during that period consisted of a drift and some stopes below the western edge of a large open cut on the northwest side of the old road to Washington, a drift ending in a short raise that led into a stope that in turn opened into a smaller open cut at the surface on the southeast side of the road, and several small pits (see fig 5). The old underground workings have long since caved

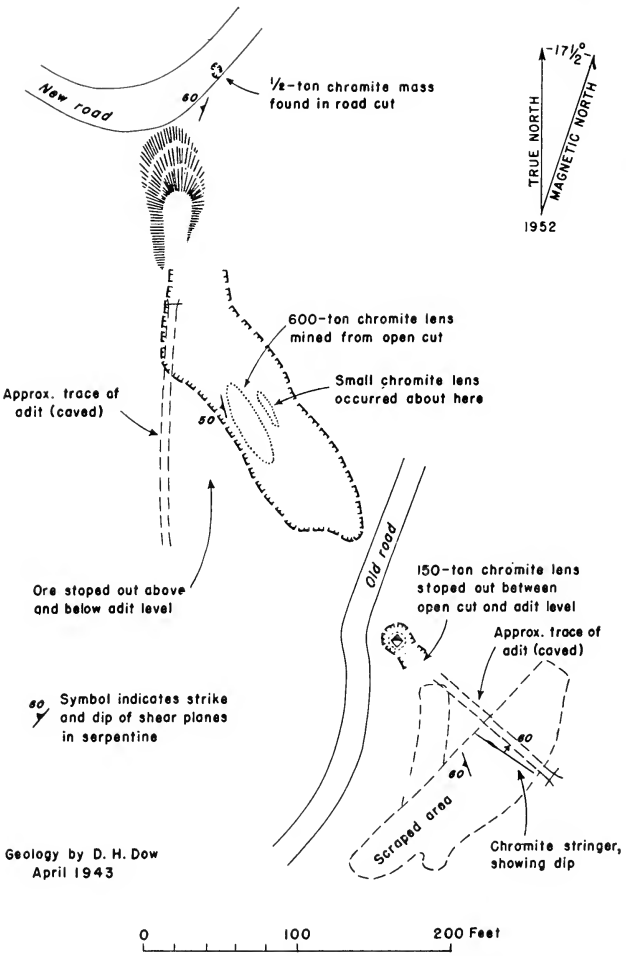

FIGURE 5. Geologic sketch map of the Red Ledge chromite mine, Nevada County

and now are inaccessible. In 1942 the surface of a small area at the southeast end of the deposit was scraped off with a bulldozer in an unsuccessful attempt to find another large ore body.

The deposit occurs near the eastern edge of the serpentine mass. Figure 5 shows that the deposit as a whole has a general strike of about N. 30° W. and a dip of 50°-60° SW., but the orientations of the individ-

ual ore bodies, and of the shear planes in the serpentine enclosing them, vary considerably from the average and from each other.

Most of the ore mined during World War I came from the workings northwest of the road. A large body of ore about 50 feet long and 20 feet wide at the surface was mined in the open cut to a depth of 10 to 30 feet, where it narrowed to a width of about 10 inches. An adit then was run southward from one side of the open end of the cut to provide better access to the ore at depth. This adit encountered either a downward continuation of the large ore body or else other discrete ore bodies, which were stoped out above and below the adit. A small ore body only 2 feet wide and 8 feet long was found about 8 feet from the footwall of the large ore body, and was mined from the open cut. The ore bodies mined from these workings yielded approximately 1,100 long tons of ore.

Another ore body was mined from the workings southeast of the road. An open cut about 20 feet wide and 40 feet long was made on the outcrop, then an adit was driven beneath the cut and the ore remaining was stoped out from below. Approximately 150 long tons of ore came out of these workings.

A bulldozer uncovered a thin stringer of chromite near the southeast end of the deposit in 1942. This stringer was only about 4 inches wide, except at one place, where it swelled out into a pod of ore that weighed about 3 tons. Five tons of ore had been mined from the stringer and pod and was piled nearby in 1943.

A small mass of chromite weighing about 1,000 pounds was found in the sheared serpentine at the northwest end of the deposit while the new road to Washington was being constructed.

Although the ore in the deposit consisted largely of massive chromite, much of it was shattered and broken and the pieces were coated with talc and kammererite and a little uvarovite. A newly recognized mineral called chromrutile occurred as small, brilliant, black crystals with kammererite on some pieces of the ore. The massive chromite, in itself, probably contained about 48 percent Cr_2O_3, but the ore shipped averaged only about 42 percent Cr_2O_3, being diluted by seams of serpentine, the coatings of talc and other secondary minerals, and fragments of waste rock admixed in mining.

The partnership of the Williamson brothers and Mr. Cole reported a production of 402 long tons of ore in 1916, 384 tons in 1917, 230 tons in 1918, and 359 tons in 1919, or a total production of 1,375 long tons during World War I. Of this total amount of ore, about 1,260 tons came from the Red Ledge mine and the remainder came from two or three other deposits exploited by the partnership. It is assumed that the 5 long tons of ore mined in 1942 has been shipped.

Despite the unsuccessful efforts to find a sizable new ore body during World War II, when the market price for chromite was high, the deposit would seem to have a fair promise of future production. A block of unexplored ground at least 100 feet long between the two principal ore bodies mined in the past could easily contain one or more ore bodies of appreciable size and should not be overlooked if additional exploration is undertaken. (Dow 43; Gordon 28; MacBoyle 19; Bradley 18; Louderback 18; Logan 18; Cameron 18; Waring 17)

Victory Claim (9)

A. Schwartz located the Victory claim about 1941 on a chromite deposit near the south edge of the SE¼ sec. 13, T. 17 N., R. 10 E., about 200 yards east of the highway to Washington. The deposit was owned and operated by George Scott as the Mount Hill Chrome mine in 1917-18. The workings in 1917 consisted of a pit 6 feet wide, 14 feet long, and 10 feet deep and another pit 14 feet to the south that was 8 feet in diameter and 6 feet deep. Gros noted three sloughed pits along an east-west line 40 feet long in 1942.

The large pit was made on a lens of massive ore striking N. 10° E. and dipping 65° E. with a pitch to the south. When Waring visited the property in 1917 this ore body was exposed for 5 feet along the strike in the south end of the cut to a depth of 5 feet and was 4 feet wide. The other pit had been made in the red clay and soil and had yielded a few tons of float ore. Gros reported that additional float had been recovered from the overburden in 1941, but the pits had been filled with mud washed in by the winter rains and he could not verify Schwartz' claim that ore 5 feet wide and at least 2 feet deep existed in the bottoms of the three pits.

Scott reported that 35 long tons of ore mined by him and 31 tons mined by a lessee was shipped in 1917 and that he considered the deposit worked out. About 50 long tons of ore was piled on the dump in 1942. The amount of ore, if any, shipped from the deposit during World War II is not known, as the separate identity of any ore shipped does not appear in the records. However, it is possible that ore was shipped in 1942 and was included in the production figures of an independent buyer. (Gros 42; MacBoyle 19; Bradley 18; Waring 17)

Olsen Prospect (10)

Karl Olsen of Washington reported that about 10 long tons of ore had been mined by him in 1917 at a prospect in the Washington area. Londerback listed Olsen's prospect as being in sec. 24, T. 17 N., R. 10 E. (probably on the northern edge of the NE¼ near the Mount Hill or Victory deposit), and indicated that 10 tons of ore containing about 40 percent Cr_2O_3 still was on the ground after the property was abandoned in September 1918. It may be that no ore was shipped. (Londerback 18)

Lowell Hill Area

Bartholomew-Simms Lease (11)

E. I. Bartholomew and William Simms held a lease in 1918 on a chromite deposit on property of the Swedish-American Bank in the NE¼ sec. 7, T. 16 N., R. 11 E. Two adits, one 18 and the other 20 feet long, were driven one above the other northward along the strike of what appeared to Cameron to be a single ore body dipping about 60° E. Ore about 2 feet wide was exposed in the backs and floors of both adits for their entire length. About 15 long tons of development ore had been mined by September 1918, but none had been shipped. Cameron thought that the deposit should yield 100 to 200 long tons of ore. Since no shipments from the deposit have been recorded, and since it is three-quarters of a mile by trail from the nearest road, the ore still may remain on the property. (Cameron 18)

Maguire Prospect (12)

William Maguire reported that he mined 2½ long tons of ore from a chromite deposit in the E½SW¼ sec. 8, T. 16 N., R. 11 E., which he

leased from Lowell Hill Gold Mines in 1918. No other information concerning the deposit is available.

Nevada City-Grass Valley Area

Sherman Ranch (15) [33]

Chromite deposits occur on the Sherman Ranch in the SW¼SE¼ sec. 11, T. 16 N., R. 8 E. This property generally has been referred to as the Hoeft lease because Eleanor E. Hoeft, the principal operator, worked the deposits during World War I under a lease from Isabelle C. Sherman, the owner at that time. During the initial operations some shipping-grade ore (float?) was sluiced off the hillside and a small lens of disseminated ore was mined from the lower slope. The major part of the work done during Miss Hoeft's operations was on a large body of disseminated ore near the top of the ridge. This ore body was adjacent to the border of the Waite Property (16) and may have been a continuation of the deposit mined on that property. The workings on the larger ore body consisted of an inclined shaft sunk 47 feet in the ore and a drift driven southwestward from the bottom of the shaft. According to Cameron, the drift was holed-out at the surface before operations were suspended.

The large body of disseminated ore had a northeast strike and a dip of about 50° SE. The shaft encountered ore, 12 feet thick at places, most of the way to the bottom. The drift was in ore as much as 10 feet thick for at least 30 feet from the bottom of the shaft, and a small stope was made in mining a part of this ore. According to MacBoyle, "a horse of hard fine-grained black rock," probably a dike of some sort, cut through the ore body at the drift level.

Approximately 500 or 600 tons of mine-run disseminated ore containing 10 to 15 percent Cr_2O_3 was taken to the Champion mill to be concentrated. The concentrates made from this ore contained only about 32 percent Cr_2O_3 and had a high iron content. Miss Hoeft reported that 146 long tons of ore was shipped by her in 1918. A small part of the ore shipped was lump ore, obtained by the sluicing operations, but the major part was concentrate. (MacBoyle 19; Louderback 18; Bradley 18; Logan 18; Cameron 18)

Waite (White) Property (16) [33]

The largest deposit found on the Sherman Ranch also extended across the property line onto the adjoining Waite property, which was reported to be owned by Matthew Waite et al. in 1918 and by B. C. Waite in 1941. The Waite part of the deposit lies in the E½SW¼ sec. 11, T. 16 N., R. 8 E. The Nevada County Chrome Co. (F. S. Morgan, E. J. Morgan, and E. E. Leichter) leased and mined on the property during 1916-18. This company opened the northeastern part of the ore body with an open cut 20 to 25 feet wide, about 100 feet long, and 20 to 30 feet deep. The open cut extended to within 20 feet of the property line.

The ore body at the Waite end was 20 to 25 feet wide and contained 10 to 15 percent Cr_2O_3, being somewhat higher in grade at the bottom of the pit than near the surface. Several (three?) thousand tons of the ore was mined from the cut and hauled to the Onstonah mill for concentration. The recorded figures of the Nevada County production of the Nevada County Chrome Co. vary considerably, but indicate that 400 to 500 long tons of concentrate containing about 36 percent Cr_2O_3 was made. All but about 25 tons of this concentrate came from ore from the Waite property. (Averill 41; MacBoyle 19; Louderback 18; Bradley 18; Logan 18; Cameron 18)

Merrifield Property (17) [33]

A small deposit of disseminated ore on the property of Albert Merrifield in the $SW\frac{1}{4}$ sec. 11, T. 16 N., R. 8 E., was leased to the Nevada County Chrome Co. in 1918. This company opened a lens of low-grade ore in a shaft 30 feet deep. Cameron reported that the ore body was at least 6 feet wide in the bottom of the shaft, and may have been even wider, as the hanging wall was not exposed at that depth. The strike of the ore was northwest and the dip about 80° SE. The disseminated ore contained about 10 percent Cr_2O_3, but small "bunches" of shipping-grade ore, containing about 36 percent Cr_2O_3, occurred in the disseminated ore and was sorted out for shipment direct. Not more than a few hundred tons of the disseminated ore was sent to the Oustomah mill for concentration. Probably not more than 25 long tons of concentrate, containing about 36 percent Cr_2O_3, was made from ore from this deposit, but the exact amount is not known, as the amounts of concentrates made from the various ores sent to the Oustomah mill were not reported separately. (Cameron 18)

Eden Claim (18)

Charles Eden located a chromite claim in the $E\frac{1}{2}$ sec. 10, T. 16 N., R. 8 E., and in 1918 he mined a few tons of ore from a small pit and a shaft that was 12 feet deep. Cameron saw one lens of ore 2 feet wide in the side of the shaft when he visited the property. Although the ore appeared to be massive chromite, a sample of "high-grade" assayed only 25 percent Cr_2O_3. A few tons of the ore was sold at $10 per ton in the spring of 1918, but the low grade of the ore discouraged the operator from attempting to dispose of more. (Cameron 18)

Porter Property (19) [34]

Two chromite deposits on land owned by J. C. Porter in the $N\frac{1}{2}NE\frac{1}{4}$ sec. 16, T. 16 N., R. 8 E., were leased by A. J. Schmidt in 1918. The larger of the two deposits was opened first by two open cuts, one of which extended to a depth of 25 feet. A shaft then was sunk to a depth of 40 feet between the two cuts and a drift was driven below the larger of the two cuts from the bottom of the shaft. Ore 4 feet wide was exposed for 35 feet along the back of the drift when Cameron visited the property. The strike of this ore body was a little north of west and the dip about 85° S. Another lens of ore 4 feet wide was exposed in the face of a short drift from the bottom of a shaft 25 feet deep, which was located about 350 feet from the main workings.

The ore in these two deposits apparently consisted of a good grade of disseminated ore that could be sorted to a product containing 31 to 33 percent Cr_2O_3, and part of the ore shipped from the property consisted of sorted material. The operator also sent some of the mine-run ore to the Champion mill, where it was concentrated to a product containing 37 to 40 percent Cr_2O_3. Schmidt reported to the State that he mined about 1,200 short tons of ore containing 30 to 32 percent Cr_2O_3 in 1918. His report to the U. S. Geological Survey indicated that he shipped 893 long tons of ore and had 178 tons on hand at the end of 1918. It is not known if the stocked ore was shipped at a later date.

Cameron's report on the property did not state definitely that the two ore bodies had a line of strike common to both. If such a relationship could be demonstrated, the block of ground between the two shafts might well contain other bodies of similar ore. (Louderback 18; Cameron 18)

Snyder Property [34]

Averill visited a chromite deposit in sec. 15(?), T. 16 N., R. 8 E., on land owned by Henry Snyder in 1941. According to Snyder, ore valued at $10,000 to $12,000 (200 to 300 tons?) had been taken from the deposit during World War I. This ore was said to contain about 40 percent Cr_2O_3. No separate production record for this deposit has been reported. It is possible, however, that the deposit may represent one of those that A. J. Schmidt mined in 1918. (See under Porter property.) No other information concerning this property is available. (Averill 41)

Mulcahy Prospect (20)

Mulcahy Bros. of Grass Valley opened a small chromite prospect in sec. 16, T. 16 N., R. 8 E., in 1918. Louderback's tabulated report noted that about 20 tons of ore containing 35 to 40 percent Cr_2O_3 and about 100 tons of ore containing 8 to 10 percent Cr_2O_3 was in sight at the prospect in 1918. No shipments of ore from this deposit have been recorded separately. (Louderback 18)

Standard Mine (21)

According to L. W. Williams of Grass Valley, about 30 long tons of low-grade ore was mined during World War I from small lenses of chromite on a property known as the Standard mine in the NE¼(?) sec. 21, T. 16 N., R. 8 E. The Hennessy Estate owned this property in 1941. No other information concerning this chromite deposit is available. (Averill 41)

Codd Prospects (22)

A. A. Codd of Reno had a lease to mine chromite on 56 acres of patented land (owned by H. B. Skewes?) and located two chromite claims in the NE¼ sec. 21, T. 16 N., R. 8 E., in 1918. A number of small open cuts and pits were dug on small lenses of disseminated ore in an effort to find a sufficient quantity of milling-grade ore to justify shipments to one of the local custom mills for concentration. About 71 long tons of ore containing approximately 15 percent Cr_2O_3 was mined but no shipments were made (MacBoyle 19; Louderback 18; Cameron 18)

Holseman Mine (23)

The Holseman mine is in the central part of sec. 22, T. 16 N., R. 8 E., and adjoins the Alta Hill mine (24). J. H. Holseman owned the property during World War I and leased to a group composed of F. M. Pfeiffer, T. F. Hogan, D. Muer, T. Gill, and G. J. Hothersall. This group of lessees mined several small lenses of low-grade ore from open cuts and from a shaft 20 feet deep with a drift 20 feet long at the bottom.

The ore in the deposit apparently consisted of disseminated chromite with streaks of more massive chromite that could be sorted out. No ore was showing in the cuts when Cameron visited the property in August 1918, but some lenses of ore from 3 to 4 feet wide were exposed in the bottom of the shaft and drift. The lenses of ore occurred in a zone that had a strike close to north and a dip nearly vertical.

The ore shipped from the deposit in 1918 contained 30 to 33 percent Cr_2O_3. That shipped in 1916 and 1917 might have been slightly richer. Hogan and Hothersall, the principals of the group of lessees, purchased ores from several sources other than the Holseman mine; the amounts of ores from the other sources were not reported separately in the pro-

duction figures reported by these men. Furthermore, the figures recorded under their names vary widely. According to Federal figures, which seem to be the best available in this case, Hogan and Hothersall shipped 353 long tons of ore in 1916, 446 tons in 1917, and 80 tons in 1918, with stocks of 161 tons on hand at the end of 1918. The Federal figures show a total of 879 long tons shipped and 161 tons stocked. The major part of the ore shipped by Hogan and Hothersall probably came from the Holseman deposit. Louderback's tabulated report indicated that 50 to 100 tons of milling-grade ore containing 10 to 18 percent Cr_2O_3 remained on the property late in 1918. (MacBoyle 19; Louderback 18; Cameron 18)

Alta Hill Mine (24) [35]

The Alta Hill chromite mine is on the old Cantwell Place located near the center of sec. 22, T. 16 N., R. 8 E., on the north side of the ridge road between Grass Valley and Nevada City. The Holseman and Grass Valley Extension properties adjoin on the north and south respectively. W. F. Man, O. R. Heidrick, and L. W. Williams owned and operated the mine during most of 1918, but leased to A. A. Codd during the latter part of that year.

Several small lenses of ore were mined from two groups of workings about 100 feet apart. The workings consisted of some open cuts and two shafts. The easternmost shaft was 30 feet deep with a drift about 50 feet long at the bottom. The other shaft was about 20 feet deep. When Cameron visited the property in 1918 he saw a lens of ore 4 feet wide in the bottom of one shaft, a lens 6 feet wide in the bottom of the other shaft, a lens 7 feet wide in one cut, and a lens 2 feet wide in another cut. These ore bodies had a northwest strike and a dip of about 85° NE. The ore in the lenses was rather low in grade; that shipped contained only 31 to 36 percent Cr_2O_3. Some lower-grade material evidently occurred also, as Louderback's tabulated report referred to about 250 tons of milling-grade ore containing 15 to 18 percent Cr_2O_3. This same report stated that 150 tons of ore was shipped from the property in 1918. However, Williams reported shipments of only 117 long tons of ore and stocks of 61 tons in his 1918 report to the U. S. Geological Survey. In 1937 Williams found a market in San Francisco for about 60 long tons of the stocked ore when foreign ores were tied up at the docks because of a strike. (Averill 41; MacBoyle 19; Louderback 18; Logan 18; Cameron 18)

Davey Prospect (26)

C. W. and W. J. Jenkins held a lease in 1918 from J. Davey & Son on 40 acres of patented land in the NW¼ sec. 26, T. 16 N., R. 8 E. The lessees mined a small lens of chromite weighing only 2 or 3 long tons from a pit 6 feet in diameter. The lens had a northwest strike and a vertical dip. Some float ore was found on the property also. (MacBoyle 19; Cameron 18)

Baker Prospect (27)

D. Whilden made five small open cuts in 1918 while prospecting small occurrences of disseminated ore on the Baker property in the NE¼ sec. 26, T. 16 N., R. 8 E. No ore was shipped. (MacBoyle 19; Cameron 18)

Spring Hill (28)

About 10 long tons of chromite was mined during World War I on the property of the Spring Hill Gold Mines, Inc., in the $S\frac{1}{2}SE\frac{1}{4}$ sec. 23, T. 16 N., R. 8 E. Waring reported that a Mr. Woil sold 10 long tons of ore containing 56.68 percent Cr_2O_3 in 1917, which came from a deposit in this vicinity. It seems likely that Woil's ore came from the Spring Hill property. A little prospecting was done on the property in 1940, but very little chromite was found. (Averill 41; MacBoyle 19; Bradley 18; Waring 17)

Golden Gate (29)

A Mr. Baskin leased the rights to mine chromite in 1918 on the property of the Golden Gate Mining Co. in the northeast corner of sec. 26, T. 16 N., R. 8 E. Two small prospect pits were dug on small "bunches" of chromite in the serpentine. The lessee intended to sink a shaft on the best showing, but it is not known if this was done. As far as is known, none of the ore was shipped. (MacBoyle 19; Cameron 18)

Geach Property (30)

A deposit of chromite on the property of T. R. Geach in the $NW\frac{1}{4}$(?) sec. 25, T. 16 N., R. 8 E., was leased and mined by C. W. and W. J. Jenkins in 1918. Their workings consisted of a shaft 20 feet deep with a short drift and an underhand stope at the bottom. About 40 long tons of massive ore had been mined when Cameron visited the property. Ore 2 feet wide showed in the face of the drift and ore 10 inches wide was exposed for a distance of 8 feet in the bottom of the stope. The strike of the ore body was N. 45° W. An outcrop of chromite was found about 50 feet along the strike from the shaft, but it is not known if any work was done at this place. The lessees reported that they mined and shipped 43 long tons of ore containing 34.27 percent Cr_2O_3 in 1918. Most of this ore probably came from the Geach property, though some may have come from the Davey property. (MacBoyle 19; Cameron 18)

Section 19 Prospects (31)

The only serpentine that has been mapped in sec 19, T. 16 N., R. 9 E., is a small mass in the southwest corner of the section, but there may be other small masses that have not yet been mapped. Two chromite prospects have been reported in the section, and both probably are located in the $SW\frac{1}{4}$ of the section.

A. E. Hooper prospected for chromite on a 75-acre tract of patented land in 1918, but found only a small stringer of ore that was not large enough to justify any work. The operators of the Red Ledge mine, the Williamson brothers and C. M. Cole, located a claim in the section in 1918 because of some chromite float they found there. A small pit and a few prospect holes and trenches were dug, but apparently the source of the float was not found. (MacBoyle 19; Cameron 18)

Chromite Concentrating Plants (13, 14)

Two large gold mills in the county were partly converted in 1918 to treat low-grade chromite ores from deposits near Nevada City. Although several hundred tons of concentrate was produced in these mills, the available reserve of low-grade ore was small, and it was found that the grade of the ores treated could not be raised high enough to justify the added expense of treating such small tonnages.

The Oustomah mill (13), located near the center of the line between secs. 1 and 12, T. 16 N., R. 8 E., treated ore from the Waite and Merrifield deposits. The mining and milling operations were carried on by the Nevada County Chrome Co. Ten 1,250-pound stamps were utilized to crush the ore through 15-mesh screens, discharging into a Hendy hydraulic classifier. The overflow from the classifier went to a Johnson belt concentrator, which yielded a fine concentrate. The coarser material went to the first Overstrom Universal concentrator, which produced some concentrate and also a middling product that was returned for further crushing. The tailings from the Johnson and the first Overstrom concentrator were run over a second Overstrom concentrator to make the final concentrate. A concentrate containing about 36 percent Cr_2O_3 and about 10 percent Fe was made from ore containing 10 to 15 percent Cr_2O_3. About 500 long tons of concentrate was made from approximately 3,000 tons of mine-run ore in 1918. The recovery was estimated to be 60 to 70 percent.

The Champion mill (14), on Deer Creek near the line between the $SW\frac{1}{4}$ sec. 12 and the $SE\frac{1}{4}$ sec. 11, T. 16 N., R. 8 E., treated ore from the Sherman Ranch and Porter deposits. The concentration process was relatively simple. The ore was crushed by two batteries of five 1,250-pound stamps through 40-mesh screens. The pulp flowed without classification to a double-deck Diester table, where some concentrate was recovered. The middlings from this table went to a single-deck Diester table, where more concentrate was recovered. The overflow from the second table was sent to a Union vanner for the recovery of the fine chromite. Some 500 to 600 long tons of ore from the Sherman Ranch deposit was crushed and concentrated. This ore contained 10 to 15 percent Cr_2O_3 and yielded approximately 125 long tons of concentrate containing about 32 percent Cr_2O_3 with a high iron content. It is not known how much ore from the Porter deposit was treated at the mill, but the mill feed from these deposits contained 30 percent or more of Cr_2O_3 and yielded a concentrate containing nearly 40 percent Cr_2O_3. The simple circuit of the Champion mill accomplished a recovery of 65 to 75 percent of the chromite in the ore. (MacBoyle 19; Bradley 18; Cameron 18)

Chicago Park Area

Shrull Prospect (35)

J. H. Shrull found about 400 pounds of float chromite on his property in the $E\frac{1}{2}SW\frac{1}{4}NW\frac{1}{4}$ sec. 17, T. 15 N., R. 9 E. The source of the float was not located.

Numitor (36)

W. C. Jauch of Colfax found some chromite float along a creek bottom in the $NE\frac{1}{4}$(?) sec. 14, T. 15 N., R. 9 E., in 1918 while he was leasing the Numitor gold mine from the Pushek Estate. The source of the float was not discovered, no other work was done, and no ore was shipped. (Cameron 18)

Moulton Prospects (37-39)

W. S. Moulton leased the rights to mine chromite on three patented properties in the Chicago Park area in 1918. Several occurrences of chromite were prospected, but no ore was shipped. About 3 long tons of ore was taken from a series of several small lenses on the Schmidt prop-

erty (37) in the SW¼ sec. 21, T. 15 N., R. 9 E. The ore zone had a north strike and dipped about 65° W. No ore remained in place at the prospect.

A shaft 12 feet deep and several small pits were made on the Weisgien property (38), also in the SW¼ sec. 21. A few tons of massive ore was taken from the shaft, where a 10-inch zone of disseminated ore with occasional "bunches" of massive ore had been opened. The ore zone had a northwest strike and dipped 80° NE.

Another zone of disseminated ore was prospected on the Rolpholm Ranch (39) in the N½ sec. 28, T. 15 N., R. 9 E. Several pits were dug along the zone, which had a strike of N. 55° W. and a dip of 45° NE. One pit 7 feet deep showed the zone to be 4 feet wide at that point. About 2 tons of ore was taken from the small "bunches" of massive ore that occurred within the disseminated ore. This property was leased to H. E. McClellan in 1942, but no additional work was done on the deposits. (MacBoyle 19; Cameron 18)

Wolf Creek Area

Dorsey and Ridge Claims (32)

L. V. Dorsey and D. R. Ridge of Grass Valley located four chromite claims in the N½ sec. 6, T. 15 N., R. 8 E., in 1917. Numerous small pits were made on outcrops consisting of small "bunches" of ore that was too low in grade to ship. At one place a shaft 12 feet deep had opened a lens of more massive ore 14 inches wide, which was said to contain 40 to 52 percent Cr_2O_3. This ore body had a strike of N. 60° W. and a vertical dip. Cameron reported that 50 long tons of the ore had been mined and perhaps 25 tons of ore remained unmined. In 1918 the operators reported that 54 long tons of ore containing 30 to 45 percent Cr_2O_3 had been mined but not shipped. It is not known whether any of this ore was shipped at a later date. (MacBoyle 19; Cameron 18)

Dickerson Property (33)

Dorsey and Ridge lease a chromite deposit in the N½N½ sec. 4, T. 15 N., R. 8 E., from the estate of L. Dickerson in 1918. Three small open cuts were made on a nearly vertical ore zone that had a strike of N. 40° W. Several small lenses of ore from 4 to 10 inches wide were found in the zone. The operators reported that 6 long tons of ore containing 30 to 40 percent Cr_2O_3 was shipped from the deposit in 1918. (MacBoyle 19; Cameron 18)

Bowden Prospect (34)

A deposit of disseminated chromite occurs in the extreme southwest corner of sec. 3, T. 15 N., R. 8 E. The property was owned by Mrs. L. A. Bowden in 1918. About 20 long tons of ore containing 15 to 20 percent Cr_2O_3 was mined in 1918. Louderback's report listed an estimated reserve of 50 to 100 tons of similar ore. None of the ore was shipped. (Louderback 18)

Thompson Ranch (41)

A chromite deposit was opened in 1918 on the ranch property of Herman Thompson in sec. 5, T. 14 N., R. 8 E., probably in the small serpentine mass in the eastern part of the section. Henry Yue mined the deposit under a lease from the owner. In 1918 the workings consisted of a shaft 20 feet deep and a drift 25 feet long from the bottom of the shaft. A lens of ore 3.5 to 4 feet wide was exposed in the back and face and for

17 feet along the floor of the drift. The ore body had a north strike and a dip of about 75° E. Cameron reported that 28 long tons of ore had been mined and he thought the ore body might yield as much as 300 long tons. It is not known how much of the ore was actually shipped.

Louderback's tabulated report lists two Thompson properties, one owned by E. Thompson in sec. 5 and another owned by H. L. Thompson in sec. 16. Louderback listed a 1917 production of 150 short tons of ore containing 38 to 40 percent Cr_2O_3 for the sec. 5 deposit and remarked that 50 to 75 tons of ore containing 12 to 18 percent Cr_2O_3 remained in sight. His figures for the sec. 18 deposit indicated that 20 short tons of ore containing about 40 percent Cr_2O_3 had been mined, but not shipped, and that 40 tons of similar ore was in sight. These latter figures seem to correspond more closely with those Cameron gave in his description of the deposit in sec. 5. That two separate deposits exist is not doubted, and it may be that the section locations given by Louderback were switched when his report was assembled. Another possible explanation of the discrepancy between the two reports can be drawn from a comparison of production records of deposits in the area. On this basis it could be assumed that the locations given in the Louderback report were erroneous and that the sec. 16 deposit corresponds to Cameron's sec. 5 deposit, whereas the sec. 5 deposit corresponds to the Half Chrome deposit (42) in sec. 4 (see below). However, the evidence at hand does not afford a conclusive solution of the problem. (MacBoyle 19; Louderback 18; Cameron 18)

Half Chrome Mine (42)

The Half Chrome mine, also known as the Limekiln or Wolf mine, is located in the S½SW¼ sec. 4, T. 14 N., R. 8 E. H. Thompson (E. H. Thompson?) was reported owner of the property during World War I. Guy Walsh and a Mr. Hall of Auburn operated the property in 1917-18. Their workings consisted of one pit 4 feet wide, 8 to 10 feet long, and 10 feet deep; another pit about 30 feet southeast that was 3 feet wide, 6 feet long, and 10 feet deep; and a prospect trench 2 to 3 feet wide extending northwest from the larger(?) pit.

The deposit consisted of a series of lenses of disseminated ore along a zone striking N. 40° W. and dipping 80° NE. The ore in the footwall part of the lens opened by the larger cut was the disseminated type, but that in the banging-wall part was more massive and contained some magnetite according to Waring. A "cross stringer" of nearly massive ore at the southeast end of the smaller pit was 14 inches wide, 4 feet long, and 4 feet deep. Some of this ore was said to be mixed with hematite(?). The prospect trench had traced the ore zone for about 75 feet northwestward from the larger pit.

E. H. Thompson and H. C. Schroeder shipped 49 long tons of ore containing about 35 percent Cr_2O_3 from the deposit in 1916. Walsh and Hall reported a production of 147 long tons in 1917. No production was reported for 1918, and apparently no work has been done since. (MacBoyle 19; Bradley 18; Waring 17)

Sweet Ranch (43) [36]

A chromite deposit on the ranch of John Sweet in the SE¼ sec. 4, T. 14 N., R. 8 E., was worked by several operators, including Edward Morgan and Henry Yue, during and prior to World War I. By 1918

the deposit had been opened by a large open cut from 10 to 15 feet wide, 50 feet long, and 40 feet deep, and a drift 20 feet long into the face of the cut.

The deposit consisted of a lens of disseminated ore enclosing small scattered masses of shipping-grade ore. A little ore was mined from the deposit about 1898. According to the production figures submitted by the owner, the deposit yielded 82 long tons of ore in 1916, 206 tons in 1917, and 424 tons in 1918. The figure given for 1918 appears rather high unless it includes some ore of milling-grade, as Cameron reported that only 300 tons of shipping-grade ore had been mined and not much ore of that grade was to be seen in the workings late in 1918. Although the deposit contained several hundred tons of milling-grade ore, the distance to the nearest custom mill at Nevada City was too great for profitable hauling. (MacBoyle 19; Bradley 18; Louderback 18; Cameron 18)

Tomkin Lease (44)

A deposit in the NE¼NE¼ sec. 18, T. 14 N., R. 8 E., was worked in 1943 by W. J. Tomkin under a lease from an unidentified person. Tomkin produced 11.4 long tons of ore containing 37.38 percent Cr_2O_3 and 9.43 percent Fe with a Cr to Fe ratio of 2.71. No other information concerning this deposit is available.

Sierra County

Introduction

Sierra County encompasses an area of 958 square miles between Plumas County on the north and Nevada County on the south. Most of the county is mountainous excepting a small part that is occupied by the southern end of the Sierra Valley. The county is one of the least densely populated counties in the State, having only 2,361 inhabitants by the count of the 1950 census. The principal industries are mining, lumbering, and farming, the latter industry being restricted mainly to the region of the Sierra Valley.

The geology of Sierra County is similar in most respects to that of the central and eastern parts of Nevada County (see pl. 12). The "great serpentine belt" extends northward from Nevada County across the western part of Sierra County through the Forest, Downieville, and Gibsonville-Poker Flat areas. Between the North Fork and Middle Fork of the Yuba River the belt constitutes a broad zone of numerous large and small masses of ultramafic rocks closely associated with masses of gabbro and gabbro-diorite. The complex geology of this part of the belt has been mapped in considerable detail (Ferguson 32) but is much generalized on plates 12 and 13. The ultramafic and mafic rocks in the main part of the wide zone were intruded into the Tightner, Kanaka, and Relief formations of Carboniferous age. North of the North Fork of the Yuba River the margins of the main part of the zone converge northward and include one relatively large and three relatively small sill-like masses of ultramafic rocks, and fewer masses of mafic rocks than to the south.

The long, narrow sill-like mass of ultramafic rocks that lies along the contact between the Cape Horn and Delhi formations from 1 to 2 miles west of the main part of the "great serpentine belt" is considered a part of that belt for the purposes of this report. The mass may have been intruded along a separate structure, however, for the strike of the

Table 10. Chromite production from Sierra County, California (in long tons)

Property	Map number	Pre-1916	1916	1917	1918	1919-41		1942	1943	1944-49		Total	Total unofficial estimate*
						Year	Tons			Year	Tons		
Brandy City	15-17	[1]											100±
Carter						1919	[a](20)						
Casserly	13				[1]								40
Croesus	25				[1]								10
Cuffe								40				40	40
Dorriss	23, 24				[1]								75
Evans	22				[1]								4
Finan	21				[1]								8
Flynn and Woods	28				[a]5							5	5
Gibsonville	1-3			83	89	1919	[b](90)					172	[c]250±
Golconda Fraction	7							70		1944	10	80	80
Good Hope Extension No. 2	11				[2]								[2]
Good Luck						1919	[b](10)						
Lucky Strike						1919	[b](31)						
						1921	[b](10)						
Macchaus	26				[a]188							188	188
McCormick	27				[1]								5
Milton	14					1941	102	5				107	[c]250
Oxford	9-11				[a]240	1919	[b](45)	10	231	1944	37	518	525±
Pilot Peak						1919	[b](89)						
Roupe	18	[1]	[a]135	[1]	95	1919	[b](71)						
						1921	[b](89)					230	400±
Skeyer						1919	[b](16)						
South Star	19				[3]								25
Tip Top						1919	[b](89)						
White Bear	6				[a]288	1919	[a]67		41			396	375±
Totals			135	83	905		169	125	272		47	1,736	2,380±
Federal totals				83	202								
State totals			135		721								

* Totaled separately. Estimates based on information obtained from all available sources.
[a] Amount reported to California Division of Mines.
[b] Ore reported stocked at end of previous year, not added because some may be below shipping-grade or because some may have been shipped under another name in a subsequent year.
[c] Includes some ore that may remain on property.
[1] Some production reported, but amount not specified. May be included in production credited to other properties.
[2] Included in production of Oxford mine.
[3] Included in production of White Bear mine.

northern end of its outcrop diverges appreciably westward from the strike of the main part of the belt.

Two other belts of ultramafic rocks, one in the Sierra City area in the east-central part of the county and the other in the Brandy City area on the western edge of the county, are not related structurally to belts in Nevada and Placer Counties. The eastern belt comprises a northwest-trending series of long, thin sills of ultramafic rocks intruded into the Blue Canyon formation (basal part of the section?) near its eastern margin. The western belt is represented by a large, highly irregular mass of ultramafic rocks intruded into rocks of the Delhi formation and schistose amphibolitic rocks of uncertain age and derivation.

Between 25 and 30 chromite deposits have been found in the ultramafic rocks of Sierra County. Only one deposit has been found in the eastern belt and perhaps as many as four have been found in the western belt; the locations and separate identities of two deposits reported in the western belt are uncertain. All the rest of the known deposits in the county occur in the ultramafic rocks of the "great serpentine belt."

History and Production

Sierra County does not rank among the prominent chromite-producing counties of California, as its deposits have yielded only about 2,400 long tons of ore. The first chromite mined and shipped from the county came from a deposit near Brandy City. About 100 tons of refractory ore from this deposit was shipped in 1905 for use in furnace linings. Another deposit in the western belt was opened in 1914. All the other known deposits in the county were exploited first during 1917-1918. Only five of these previously worked deposits yielded additional ore during World War II, and nearly half the ore produced during that period consisted of concentrates made from the disseminated ore in a deposit in the Downieville area.

None of the deposits found thus far have contained more than 500 long tons of shipping-grade ore and only seven have contained more than 100 tons. The known and inferred reserves of these deposits probably do not add up to more than a few hundred tons of ore. The ultramafic rocks in the Forest area have been prospected thoroughly, but additional prospecting in the other areas might lead to the discovery of other ore bodies. As in the past, the difficulties and high costs of transporting the ore to distant markets will be a serious handicap to operators who may attempt further exploitation of the deposits.

Detailed production figures for deposits in the county are given in table 10.

Mines and Prospects

Gibsonville-Poker Flat Area

Gibsonville Property (1-3)

Six chromite claims, known collectively as the Gibsonville property, were located on the serpentine mass on Slate Creek in sec. 29, T. 22 N., R. 10 E., between Gibsonville and Mount Filmore, by W. T. Baldwin, L. L. Clough, and G. W. Chamberlin during World War I. Five of the claims—the Chrome 1, 2, 3, 4, and 5 claims—were held jointly and the sixth was held outright by Clough. Chromite was mined from three of these claims in 1917, and mining operations on the property probably were carried on during 1918 also; but it is not known if additional work has been done since.

The workings of the No. 1 claim are at an altitude of about 5,300 feet on the east side of Slate Creek about 300 feet west of the old Gibsonville-Howland Flat road. An ore body striking east and dipping 85° S. was being mined from an open cut 16 feet long and 10 feet deep when the deposit was visited by Waring in 1917. Approximately 20 long tons of ore had been mined at that time; and an additional 20 tons of unmined ore might extend into the hillside.

Another ore body was mined on the No. 2 claim above the Howland Flat road at an altitude of about 5,800 feet on the ridge northeast (east?) of Gibsonville. This chromite lens was 14 feet long, 4 feet wide, and 5 feet deep and had a strike of N. 45° E. and a dip of 80° NW. It yielded about 8 long tons of ore containing 38 to 40 percent Cr_2O_3.

Clough's claim was on the southeast slope of the above-mentioned ridge. A "chimney" of chromite on this claim yielded about 35 long tons of ore containing 45 percent Cr_2O_3. The maximum cross-section of the ore body was 6 by 8 feet; the body pinched out at a depth of 10 feet.

W. T. Baldwin reported that 83 long tons of ore containing 44 percent Cr_2O_3 was shipped in 1917. This amount corresponds exactly with the amount Waring reported for the three deposits described above. Baldwin also reported 89 long tons shipped and 90 tons stocked in 1918. It is not known from which, if any, of the six claims this 1918 production came or if any of the ore reported as stocked has been shipped since. (Bradley 18; Waring 17)

Poker Flat Prospects (4, 5)

E. R. Jones and A. J. Modglin of La Porte have reported occurrences of chromite in and near sec. 16, T. 21 N., R. 10 E. The only serpentine mapped in sec. 16 is a thin sill in the southeast corner, but it might well contain a few deposits of chromite. A wider mass of serpentine in the central part of sec. 15 between Deadwood and Little Grizzly Creeks is said to contain about 200 long tons of visible ore occurring mostly as large boulders of float. Apparently but little work has been done on these occurrences, and no production has been reported from the area. Additional prospecting seems to be warranted. (Averill 42)

Downieville Area

White Bear Mine (6) [27]

Chromite occurs on the property of the White Bear Mining Co. in secs. 9 and 16, T. 20 N., R. 10 E. Richard Belcher is secretary of the company, which owns five claims covering a length of about 1½ miles of a gold-bearing channel between the Tertiary lavas and the underlying bedrock. John Costa of Downieville was operating the mine for gold in 1918, and the Ostrom and Lindvall brothers mined chromite under a lease from him. G. R. Costa and R. Daneri of Downieville and E. C. Willis of Hayward were working the mine for gold under a lease in 1941 and saved a small amount of chromite cobbles found in the gravels. The only shipments of chromite from this mine during World War II are credited to C. L. Best of the Ruby-Oxford Mines, who apparently leased the chromite mining rights in 1943.

Little has been reported regarding the geology of the chromite deposits. Thompson's 1918 report indicates that one or more lenses of ore were mined from an open cut in the serpentine. He stated that this deposit had a maximum length of 20 feet, a maximum width of 8 feet, and a

depth of 26 feet; the strike was north and the dip was 40° E. Ostrom and Lindvall Bros. reported to the California Division of Mines that they shipped 288 long tons of ore in 1918 and had 67 long tons of ore on hand at the end of the year. Perhaps as much as 25 tons of this ore came from the South Star claim (19), however. The 41.4 long tons of ore shipped by C. L. Best in 1943 contained 41.41 percent Cr_2O_3 and 22.23 percent Fe with a Cr to Fe ratio of 1.86. It is not known if the ore produced in 1943 came from the same deposit worked in 1918 or if it came from a newly discovered deposit. The amount of ore that could be recovered from the gravels is negligible, and no reserves can be estimated for the property. (Averill 42; MacBoyle 20a; Louderback 18; Thompson 18)

Golconda Fraction Claim (7)

The Golconda Fraction claim is located in the northwest corner of the $SW\frac{1}{4}NE\frac{1}{4}$ sec. 22, T. 20 N., R. 10 E., about half a mile north of the Oxford mine. C. A. Winrod and G. B. Winrod owned and operated the property in 1942. C. L. Best of the Ruby-Oxford Mines conducted a small-scale operation on the claim in 1944 under a lease from the Winrods. An open cut about 40 feet long, 40 feet wide, and 15 feet deep on the uphill side constituted the only workings in 1942 (see fig. 6). The

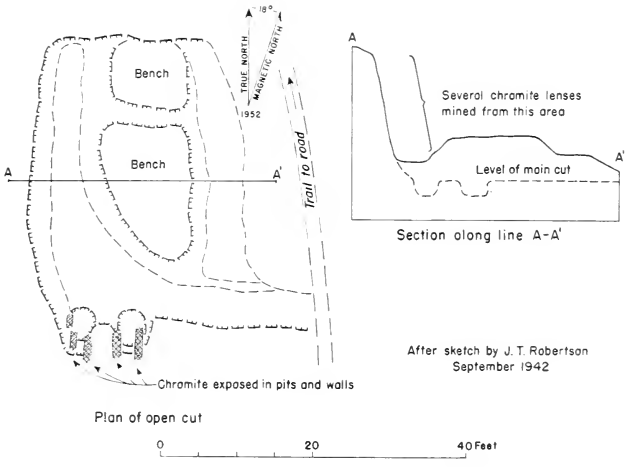

FIGURE 6. Sketch of open cut, Golconda Fraction claim, Sierra County

ore was taken out over about half a mile of rough sled road and then trucked to the Auburn stockpile.

Several 5- to 10-ton chromite lenses were taken from the open cut. These ore bodies were about 2 feet thick, 8 feet long, and 6 feet wide. The Winrods shipped 69.7 long tons of ore in 1942 and C. L. Best shipped

10.3 tons in 1944. This ore averaged 39.03 percent Cr_2O_3 and 12.20 percent Fe with a Cr to Fe ratio of 2.19. Although a possible reserve of 40 to 50 tons of ore was estimated by Robertson (42) at the end of 1942, it is probable that C. L. Best mined all the ore in sight in 1944. (Robertson 42)

Oxford Mine (9-11) and Mill (12)

Several chromite deposits have been found on the properties of the Oxford Quartz Mining Co. (see fig. 7). Chromite occurs on the Oxford

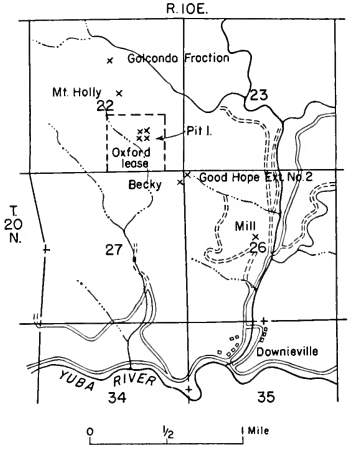

FIGURE 7. Sketch showing the location of chromite deposits at and near the Oxford mine, Sierra County

patented timber lease (9) in the $SE\frac{1}{4}$ sec. 22 and on the Good Hope Extension No. 2 (11) and Becky (10) claims in the northwest corner of sec. 26 and the northeast corner of sec. 27, T. 20 N., R. 10 E. The mill (12) is on the Portal claim at an altitude of about 3,500 feet in the southeast corner of the $NW\frac{1}{4}$ sec. 26. Some of the deposits were worked by Dan McGonigal and others during World War I. C. L. Best, owner and operator of the Ruby drift mine near Goodyears Bar, holds a 25-year option on the property and worked the chromite deposits during 1942-44. L. L. Huelsdonk was superintendent of the operations.

When the property was visited by the writer in February 1943 one deposit on the Oxford lease had been opened by a large open cut, another by several shallow open cuts and a shaft 25 feet deep with a short drift at the bottom, another by a small open cut and a short drift, and still another by a shallow trench 92 feet long. Two deposits on the Good Hope Extension No. 2 claim had been opened by several open cuts and shallow trenches. Later in 1943 several hundred feet of diamond-drill holes were drilled.

The 100-ton gold flotation mill on the Portal claim was converted to concentrated chromite early in 1943. Figure 8 shows the flow diagram

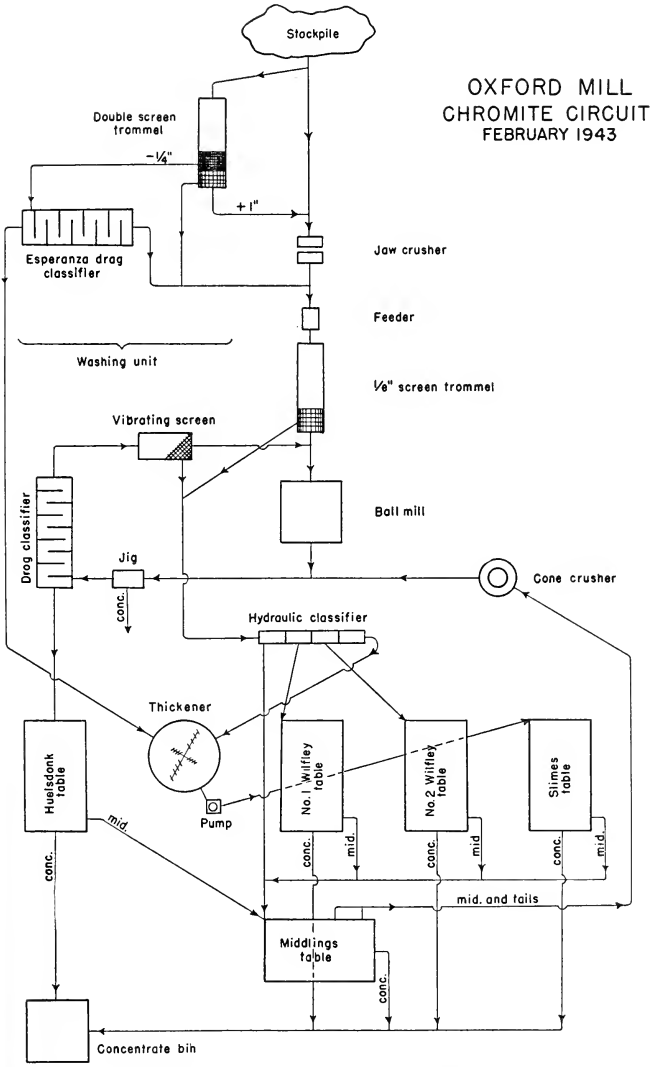

FIGURE 8. Flow diagram of the Oxford mill, Sierra County, showing the units used to concentrate chromite

and the units used. The use of the Huelsdonk table in the circuit was an innovation in concentrating chromite. Originally developed for the recovery of gold, this table does not require a rigid classification of the table heads.

The deposits occur in a sill-like mass of ultramafic rocks that has been intruded into a series of metamorphic rocks mapped by Turner (97) as part of the Calaveras formation. This ultramafic mass is 1,000 to 1,200 feet wide and its outcrop is about $1\frac{3}{4}$ miles long. Its borders are highly sheared and serpentinized, but the central portion is relatively unaltered. Saxonite predominates and encloses small, irregular masses of dunite.

The largest deposit that had been found on the property by February 1943 was on the Oxford lease. This deposit was exposed in a large open cut called Pit 1 (see fig. 9). The ore occurred as zones of rather

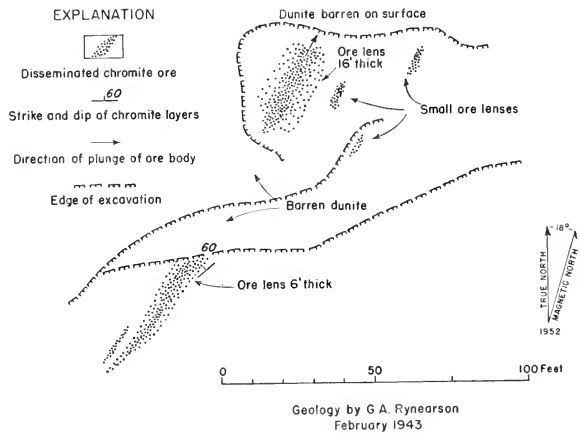

FIGURE 9. Geologic sketch map of Pit 1, Oxford mine, Sierra County

coarse grained chromite disseminated in slightly altered dunite. Poorly defined layers of chromite in some of the ore had a strike of N. 45°-55° E. and a dip of 60°-80° NW. at one place. In the upper part of the cut the zone was exposed for about 35 feet along the strike and had a maximum thickness of 16 feet. The northeast end of the zone appeared to pitch beneath the surface. Six feet of the ore in the central part of the zone contained about 20 percent Cr_2O_3, but the tenor of the remainder of the ore diminished outward to about 5 percent Cr_2O_3. In the lower part of the cut a similar zone of ore was 6 feet thick at its northeast end and lensed out about 50 feet southwestward. It could not be determined whether the two showings of ore represented discrete ore bodies or whether they were parts of one zone whose central part had been offset by small faults. However, the rocks between them appeared to be barren of chromite.

Ore occurs along a shear zone in another deposit about 600 feet west of Pit 1. Approximately 200 long tons of ore was mined and shipped

from a shaft and drift during World War I. The shaft and drift had caved by 1943, but it was reported that a lens of ore 5 inches thick remained in the face of the drift. The shear zone had been prospected for about 150 feet along its strike of N. 20° W. Disseminated ore, averaging 3 feet in thickness, had been exposed for 30 feet along the zone in the northern workings. Additional exploration might lead to the discovery of other bodies of both shipping and milling ore.

An ore zone containing coarse-grained disseminated and layered chromite had been exposed by a shallow trench approximately 100 yards north of Pit 1. This zone had an average thickness of 3 feet and a length of 35 feet. Thin layers of chromite in the ore had a strike almost due east and a dip of 60°-70° N.

Between the last two deposits described was another deposit that was reported to have yielded 15 long tons of ore containing 58 percent Cr_2O_3. This ore occurred along a shear zone, and prospecting with a bulldozer might uncover other ore bodies.

The prospects in the northwest corner of sec. 26 had sloughed and little could be ascertained about the character of the deposit. The ore is quite magnetic and apparently occurs as stringers and small pods in residual red clay and soil. A little ore was mined and shipped from this locality during World War I.

Float and small outcroppings of ore were traceable for 200 feet in a direction of N. 20° W. along the ridge in the northeast corner of sec. 27. The ore occurred as stringers and small pods in sheared serpentine near the contact with the metamorphic rocks.

Approximately 250 long tons of ore was mined and shipped from deposits in the area during World War I. The World War II operators shipped 10.1 long tons of ore in 1942, 230.9 long tons in 1943, and 36.7 long tons in 1944. Most, if not all, of the ore shipped in 1943 and 1944 consisted of concentrates, but that shipped in 1942 was lump ore mined during World War I. The concentrates averaged 40.05 percent Cr_2O_3 and 13.54 percent Fe and had an average Cr to Fe ratio of 2.02. The lump ore contained 38.59 percent Cr_2O_3, 11.50 percent Fe, and 14.0 percent SiO_2, with a Cr to Fe ratio of 2.30.

About 1,000 long tons of ore had been mined from Pit 1 by February 1943. At that time it appeared that this deposit might yield an additional 1,000 long tons of milling ore and that the deposit north of Pit 1 might yield about 250 tons of similar ore. The amount of concentrates produced indicates that approximately 2,000 long tons of ore was milled, so most of it probably came from Pit 1 and perhaps a little came from other deposits on the Oxford lease. (Rynearson 43; Averill 42 and 43; MacBoyle 20a; Louderback 18)

Sierra City Area

Milton Claim (14) [28]

The Milton claim is at an altitude of about 6,500 feet in the NE¼-SE¼(?) sec. 4, T. 19 N., R. 12 E. R. C. Zaring of Downieville and Mrs. Marie E. Phelan of Sacramento both claimed title to the property in 1943. George Redmayne and Dan McGonigal mined, but did not ship, some ore from one ore body during World War I. Zaring worked the deposit during World War II. Two open cuts constitute the only workings.

Two lenses of ore have been found in place and several tons of float has been found in the gulch below these lenses. The upper cut had sloughed so that the bottom was partly covered when Averill visited the claim in 1941, and ore could be seen in only one or two places. At one place the ore was 2 feet thick, and it appeared that the ore body might be as much as 20 feet long. About 150 long tons of ore was stacked on the dump. Zaring found another ore body 75 feet to the east and lower than the upper lens. The lower lens was 4 feet wide and was exposed for 15 feet along its strike. The lens dips 60° N. About 100 long tons of ore was stacked on the dump in 1941. A piece of this ore was analyzed by Smith Emery & Co. and found to contain 40.60 percent Cr_2O_3, 11.76 percent Fe, 0.22 percent SiO_2, and 0.10 percent P, with a Cr to Fe ratio of 2.36.

No shipments of ore from this property have been recorded under the name of either title claimant. However, a shipment of 82 long tons of ore containing about 40 percent Cr_2O_3 was reported to the California Division of Mines by James Davis in 1941. R. N. Knudsen, who trucked the ore to Auburn, informed the writer that the ore came from the Milton claim. Assuming that 82 tons of the stocks reported by Averill has been shipped, a reserve of at least 150 long tons is assured and perhaps 50 long tons or more remain unmined in the two known ore bodies. Additional exploration might well lead to the discovery of other ore bodies. (Averill 42 and 43)

Brandy City Area

Brandy City and/or Luce & Co. Deposits (15-17) [29]

Several references to the occurrence of chromite near Brandy City have appeared in the literature. The location usually given is sec. 1, T. 19 N., R. 8 E. (probably in the $NW\frac{1}{4}SE\frac{1}{4}$), but one early report states that chromite occurs on Cherokee Creek a quarter of a mile southeast of Brandy City, which would be in the northeast corner of sec. 7, T. 19 N., R. 9 E. Although two names—the Brandy City and the Luce & Co. mines—are given, the inference that two separate deposits exist may be erroneous, and it is possible that the two names refer to one and the same deposit, in which case the location is probably in sec. 1 rather than in sec. 7. Taylor (03) showed two locations on his map, one named Brandy City in sec. 1 and another, not named, owned by Luce & Co. in the southwest corner of sec. 29, T. 19 N., R. 9 E. The latter may be the same deposit later referred to as the Roupe deposit.

The Luce & Co. mine, an operation that may have included one or all those mentioned above, was owned and operated by D. E. Luce & Co. of Camptonville during 1905. It was reported that a "considerable tonnage" of the ore was shipped to Nevada City and that a "large" body of ore was in sight at that time. The ore was said to be unusually rich in magnesium and was used mainly for furnace linings. Neither the grade nor the amount of ore produced are known, and the deposits probably were worked out before World War I. (Averill 42; Aubury 06; Judd 05; Taylor 03; Crawford 94 and 96; Hanks 86)

Roupe Property (18) [30]

The Roupe, or Camptonville, property is reported to be in sec. 30, T. 19 N., R. 9 E., about 100 feet from the road between Camptonville and Brandy City. One located claim is owned by R. J. Roupe of Campton-

ville (W. B. Roupe of Los Angeles according to Louderback). The present owner worked the deposits during both world wars. When Gros visited the property in 1942 the workings consisted of 22 small open cuts and 3 shallow shafts.

If the location given is correct, the serpentine in which the deposits occur has not been mapped. The chromite occurs as small lenses of massive ore in residual soil and in the underlying serpentine. The serpentine is highly sheared and breaks freely from the ore. Twenty or more ore bodies have been found scattered for about 700 feet along an irregular zone, which strikes N. 36° W. and dips 80° SW. These ore bodies averaged about 15 feet in length, 5 feet in thickness, and extended to a maximum depth of 10 feet. Louderback reported that 300 short tons of ore containing 42 to 43 percent Cr_2O_3 was shipped between 1914 and 1917, 56 short tons in 1918, and that 90 short tons of ore remained in sight in the workings when operations were suspended in 1918. Gros reported that 20 long tons of ore containing 44.6 percent Cr_2O_3 was shipped in 1942, and that approximately 50 tons of ore was visible in two unmined lenses when mining was suspended for the remainder of that year. It is not known if additional mining has been done on the property since 1942. (Gros 42; Averill 42; Bradley 18; Louderback 18)

Forest Area

Dorriss Mine (23, 24)

The Dorriss chromite mine is in the $SE\frac{1}{4}$ sec. 29, T. 19 N., R. 10 E. Thompson reported that the property consisted of five located claims owned by R. Dorriss, M. H. Davis, H. M. Bradbury, and A. M. Dobbie of Forest, and that it was operated by Leichester and Morgan of Nevada City during 1918. Several small lenses of ore were mined from three shallow shafts and a small open cut. About 60 long tons of ore containing 45 percent Cr_2O_3 had been shipped by September 1918, and about 10 tons of ore remained in the workings. The total production from these workings probably did not exceed 75 long tons.

Ferguson examined a chromite prospect in 1923, which he thought was part of the Dorriss mine. This prospect is at an altitude of 4,250 feet on the south side of Oregon Creek in the $SW\frac{1}{4}SE\frac{1}{4}$ sec. 29. An adit and an irregular inclined shaft had been driven for about 50 feet along a shear zone in serpentine. No ore remained in place, but pieces of chromite on the dump indicate that some ore had been mined. A little uvarovite was noted on some of the ore. (Averill 42; Ferguson 32; MacBoyle 20a; Thompson 18; Louderback 18)

Evans Prospect (22)

Robert Evans worked a small deposit of chromite near the Dorriss mine in 1918. This deposit yielded only 4 long tons of ore from a shaft 20 feet deep. (MacBoyle 20a; Thompson 18)

Finan Prospect (21)

Steven Finan worked another small deposit of chromite near ($SW\frac{1}{4}$ sec. 29) the Dorriss mine in 1918. He mined and shipped 8 long tons of ore containing 45 to 48 percent Cr_2O_3 and left no ore in place. (Averill 42; MacBoyle 20a; Thompson 18; Louderback 18)

Macchaus Mine (26) [31]

The Macchaus mine consisted of three claims north of Kanaka Creek, probably in the $E\frac{1}{2}$ sec. 5, T. 18 N., R. 10 E. Henry Macchaus, G. E.

Redmayne, C. D. McGonigal, and Steven Finan of Alleghany owned and operated the property in 1918. From 12 small open cuts they mined and shipped 188 long tons of ore containing 46 percent Cr_2O_3. The ore occurred as small lenticular masses of chromite weighing 14 to 20 tons each. All the ore found had been mined and the property abandoned by August 1918. (MacBoyle 20a; Louderback 18; Thompson 18)

Miscellaneous Deposits (13, 19, 25, 27, 28)

Although some specific information about the following chromite deposits has been reported by Louderback (18) and to the California Division of Mines, the data are so meager that the deposits deserve only a brief mention.

W. W. Casserly of Goodyears Bar had a prospect (13) in the E½ sec. 29, T. 20 N., R. 10 E. Up to September 1918 he had mined or partly exposed about 40 long tons of ore. It is not known if this ore was ever shipped.

Ostrom & Lindvall Bros. mined and shipped 14 long tons or more of ore from the South Star claim (19) in the W½ sec. 17, T. 19 N., R. 10 E., in 1918.

About 10 long tons of ore was mined in 1918 on the property of the Croesus Gold Mining Co. (25) in sec. 5, T. 18 N., R. 10 E.

C. Y. McCormick of Alleghany mined about 5 long tons of ore in 1918 from a prospect (27) in sec. 5, T. 18 N., R. 10 E., near the Macchaus mine.

Flynn Bros. and J. J. Woods of Alleghany mined about 5 long tons of ore in 1918 from a small prospect (28) near the Red Ledge mine. The location of this prospect probably is in the southwest corner of sec. 6, T. 18 N., R. 10 E.

William Carter of Alleghany had a prospect in 1918 (location unknown) from which he mined, but did not ship, about 20 long tons of ore.

Yuba County

Introduction

Yuba County comprises an irregular area of 638 square miles that projects northeastward from the Great Valley into the Sierra Nevada between Butte and Nevada Counties. Its topographic and geologic features, therefore, are similar to those of the adjoining parts of those two counties. Its southwestern end is covered by Quaternary gravels and alluvium. The remainder of the county is composed largely of various metamorphosed mafic igneous rocks and of granitic rocks intruded into them. A complex area at the northeastern end includes some metasedimentary rocks of the Calaveras(?) formation and some irregular masses of ultramafic rocks and gabbro.

Only five deposits of chromite have been found in the ultramafic masses of Yuba County. All the deposits are small and the ore they contain is of a rather poor quality. The county is credited with the production of only 39 long tons of chromite, all of which was shipped from one deposit in 1942. So far as is known, no ore has been shipped from the other deposits, but it is said that 15 to 20 tons of low grade ore is on the dumps of one deposit. Most of the areas underlain by the ultramafic rocks are deeply weathered and heavily timbered. Prospecting for chromite is difficult, therefore, and it is likely that any further prospecting will be no more successful than that in the past.

Mines and Prospects

Strawberry Valley Area

Magruder Prospects (1, 2)

Two occurrences of chromite on lands of the Soper-Wheeler Timber Co. were optioned to E. C. Magruder of Strawberry Valley in 1943. One deposit is in the $NW\frac{1}{4}SW\frac{1}{4}$ sec. 15, T. 20 N., R. 8 E., about 50 yards west of the county road between Strawberry Valley and La Porte. The other deposit is in the center of the $NW\frac{1}{4}$ sec. 22 near a timber road about three-eighths of a mile southeast of the county road.

The deposit in sec. 15 had been opened by a small open cut, which was partly filled with soil and mud in April 1943. An outcrop of ore about a foot thick was exposed in the bottom of the cut, and a few hundred pounds of ore containing less than 30 percent Cr_2O_3 was stacked on the dump. It appeared that this deposit did not contain more than 5 or 10 long tons of similar ore.

The deposit in sec. 22 had been prospected by several shallow pits scattered over an area about 300 feet long and 100 feet wide. No ore had been found in place, but several hundred pounds of float ore had been dug from the thick mantle of red soil covering the serpentine. This ore averaged only about 28 percent Cr_2O_3. (Rynearson 43)

Challenge Area

Arbucco Prospects (3, 4)

A. G. Arbucco of Challenge has prospected several chromite deposits in the $SW\frac{1}{4}$ sec. 10 and the $SW\frac{1}{4}$ sec. 15, T. 19 N., R. 7 E. The prospects in sec. 10 probably correspond to the Sharrer prospects reported during World War I. According to Mr. Arbucco, all these chromite occurrences were small and only a small amount of ore is exposed in one prospect pit in sec. 15. From 15 to 20 long tons of ore averaging 33 percent Cr_2O_3 has been mined, but not shipped, from six of the prospect pits. (Rynearson 43; Bradley 18)

Camptonville Area

Ironrite Claim (5)

The location of the Ironrite claim is reported only as 3 miles north of Camptonville. A chromite deposit in this area probably would be in the long, thin mass of serpentine trending northwest across sec. 35, T. 19 N., R. 8 E. The map (pl. 13) shows the tentative location of this claim to be on this serpentine mass. However, geographic directions sometimes are used rather loosely in some reports and the deposit actually may be northeast of Camptonville in a mass of unmapped serpentine, perhaps across the boundary of Sierra County.

C. A. Winrod et al. of Downieville shipped 38.6 long tons of ore from this claim in 1942. The ore contained 38.20 percent Cr_2O_3 and 15.19 percent Fe with a Cr to Fe ratio of 1.72. No other information concerning this deposit is available.

Butte County

Introduction

Butte County covers an irregular area of 1,665 square miles at the juncture of three geomorphic provinces: The western half is in the Great Valley, the northern tip and the north-central part are in the Cascade Range, and the eastern part is in the Sierra Nevada. From southwest to northeast the land surface of the county rises rather gradually from the

flat plain of the valley over a belt of low foothills to the tilted and dissected middle slope of the Sierra Nevada. Several large creeks have cut long, narrow arroyos in the surface in the north-central part of the county, and the forks of the Feather River have cut deep canyons in the eastern part.

The 1950 census credits Butte County with 64,374 inhabitants, most of whom live in the western part of the county. This part is essentially an agricultural area, although several gold dredges and sand and gravel plants are operated on a large scale also. Farming, mining, and lumbering are the principal industries in the eastern part of the county.

In general, the transportation facilities in Butte County are adequate for most purposes. The main line of the Western Pacific Railroad runs through Oroville and thence northeast through the canyon of the Feather River, and a branch line of the Southern Pacific Railroad runs northward through Chico with spur lines to Oroville and Sterling City. A network of good roads provides ready access to all parts of the county except that portion between the North Fork and the South Fork of the Feather River. In recent years, however, several forest and timber roads have been improved and extended into this rugged eastern area and it is gradually being made more accessible.

Despite the relative accessibility and long mining history of Butte County, most of the geologic mapping that has been done in the county is of a reconnaissance nature, and many significant details of the geology remain to be worked out. The eastern half of the county is underlain by Paleozoic and Mesozoic metamorphic and igneous rocks. Large areas of this part of the county consist of undifferentiated massive and schistose amphibolites or greenstones that have been derived from various basic rocks of uncertain age. Slates of the Calaveras formation occupy a rather large part of the northeastern tip of the county, but occur in much smaller areas in the southeastern part. The slates and greenstones have been intruded by many large and small masses of ultramafic rocks and some gabbro. In turn, all these rocks have been intruded by large stocks of the satellitic batholith of granitic rocks that underlies the western margin of the northern Sierra Nevada. The characteristic north to northwest structural trend of the pre-granite rocks has been distorted markedly in some sections, evidently by forces related to the intrusion of the granitic masses.

The pre-Nevadan basement rocks of the Sierra Nevada are covered almost entirely at the northern tip and in the western half of the county by gently dipping Tertiary volcanic tuffs, breccias, and flow rocks and Tertiary and Quaternary gravels and alluvium. Small areas of the eastern margin of the Upper Cretaceous Chico formation, which is the oldest formation of the "Superjacent series," are exposed in the arroyos in the north-central part of the county, and a small area of the Chico and a somewhat larger area of the Eocene Ione formation crop out north of Oroville.

Numerous masses of ultramafic rocks are exposed in the northeastern half of the county. Not all the masses that are exposed have been mapped, however, and parts of some that have been mapped include some gabbro and also some talc, chlorite, and amphibole schists that may have been derived from less mafic rocks. A few of the smaller masses and parts of some of the larger masses, especially along their margins, have been

thoroughly serpentinized and sheared to slickentite. The distribution pattern of the ultramafic masses in Butte County is not nearly as regular as in the other counties of the northern Sierra Nevada, but the pattern appears to conform, in a general way, with the distorted, S-shaped structural trend of the older rocks (see pls. 12 and 13). The masses are arranged roughly into two nearly parallel belts. The southwest belt trends southeastward from the northeast corner of T. 22 N., R. 3 E., to the Big Bend area of the North Fork of the Feather River, eastward to the Middle Fork, and thence southward across the South Fork into Yuba County. Several small isolated serpentine masses in the Yankee Hill area also are included in this belt. The northeast belt trends a little south of east from Sawmill Peak across the North Fork of the Feather River and Big Bar Mountain into Plumas County, where, as the western belt of Plumas County, it curves sharply southward to the common intersection of the Butte, Plumas, and Yuba County boundaries. Several small masses of ultramafic rocks that have been reported, but not mapped, in the area northwest of Sawmill Peak probably represent a northwestern extension of the northeast belt, but two or more small masses near Inskip and Bald Mountain to the north are too isolated to correlate with this belt. Deposits of massive and disseminated chromite are scattered widely in the ultramafic masses of both belts.

History and Production

Butte County is one of the few counties in California that has produced chromite since 1945, and this recent production, all from one mine, has increased the total production to approximately 7,275 long tons and moved Butte County into tenth place among the chromite-producing counties of California. Chromite deposits were recognized and reported in at least two places in the county in the early eighties, but no shipments were made until 1915; in that year several deposits near the southern edge of the county were opened. Most of the deposits found thus far were first worked during the period 1915-18. One operator erected a small mill in 1918 and produced several carloads of low-grade concentrates from the disseminated ore of two deposits in the Yankee Hill area. None of the deposits were worked between 1919 and 1941, but during World War II ore was shipped from six deposits that had been worked previously and from six deposits that were discovered in 1942 or 1943. Since 1943 the Lambert mine operators have shipped ore each year except 1948, and this mine was the only active chromite property in Butte County during 1950. Detailed production figures for deposits in the county are given in table 11.

The Lambert deposit has yielded approximately 2,700 long tons of ore (including the 1950 production) and is the largest deposit of shipping-grade ore yet found in the northern Sierra Nevada. One other deposit in the county has yielded more than 1,000 long tons of ore and another has yielded a little less than 1,000 tons; the ore taken from the latter contained only 30 to 34 percent Cr_2O_3, however. Of the other deposits that have been worked, one has yielded a little more than 500 long tons of ore and five have yielded between 100 and 300 tons. So far as is known, the ore from only four deposits contained more than 45 percent Cr_2O_3, but the Cr to Fe ratios of the leaner ores from four other deposits have exceeded 2.5. The ore in many of the deposits, notably

Table 11. Chromite production from Butte County, California (in long tons)

Property	Map number	1915	1916	1917	1918	1919-41		1942	1943	1944	1945-49		Total	Total unofficial estimate*
						Year	Tons				Year	Tons		
Anti-Axis	2								37				37	37
April Fool					[1]	1919	[c](18)							90
Bear Canyon	42				[1]									12
Big Bend	40				[a]90								90	90
Big Pine	18					1919	[b, c](245)							
Big Wonder						1919	[b, c](37)							
Christian Place	4								31				31	31
Diamond Queen	44		[1]	.										50±
Dickey and Dreisbach prospect	45			[1]										30
Dorothy						1919	[c](18)							
Dowden (shipper)				[b]33	[b]90	1919	[b, c](60)						123	150±
Green Ridge	30				94								94	94
Hendricks No. 1	29			[1]										50±
Hendricks No. 2	31				[b]143	1919	[c](27)						143	143
King prospects	10, 16				[a]17								17	17
Lambert	3			537	379				54	48	1945	22		
											1946	[a]854		
											1947	[a]216		
											1949	[a]152	2,262	2,213
Little Hope	17							22	63				85	85
Lone Star	39					1941	[1]		22				22	34
Lucky Bill	8			[1]										45
Mary Jane	19								11	30			41	41
North Star (Red Mtn.)	41				[a]85				50				135	135
Parkeson	5								31				31	31
Park's Ranch	33		[b]89	[1]	[b]207			121					417	520
Powell	43				[1]									20
P. U. P. (Zenith)	49	37	1,129	246	51			37	8				1,508	1,150±
Reynolds No. 1	13				[1]									35
Reynolds No. 2	14				[1]									10+
River Side	37								10				10	10

Section 13	24				[1]									70±
Section 35	7			[a]137	[a]64								201	201
Simmons	6			[a]46	31								77	77
Stewart	12		[a]126										126	126
Stokes prospects	11, 12				[1]									8
Suzy Bell (Lucky Strike)	46, 47	[2]	[2]	[2]	[2]			16					[d]16	300±
Swayne	25			[b]350	503	1919	[c](22)						853	900
Twin Cedars	9			20									20	20
War Bond	20-23				[1]	1919	[c](22)							
						1920	[c](18)							50±
Totals		37	1,344	1,369	1,754			196	317	78		1,244	6,339	6,785±
Federal totals		37	1,129	1,230	1,387									
State totals		80	1,296	5,133	2,969									

* Totaled separately. Estimates based on information obtained from all available sources.
[a] From private records.
[b] Amount reported to California Division of Mines.
[c] Ore reported stocked at end of previous year, not added because most is below shipping grade.
[d] Additional production included under P.U.P. (Zenith) mine.
[1] Some production reported, but amount not specified. May be included in production credited to other properties.
[2] Included in production of P.U.P. (Zenith) mine.

those in the Yankee Hill and Big Bar Mountain areas, is of the disseminated type and contains less than 35 percent Cr_2O_3.

The Lambert is the only deposit of shipping-grade ore that appears to have appreciable reserves of ore. This deposit still contains more than 500 long tons of ore and the possibilities of developing even more ore are good. Other known deposits of shipping-grade ore appear to be worked out, although further exploration might discover additional ore bodies in some of them. One deposit of milling-grade ore may hold as much as 20,000 long tons of ore containing 10 to 15 percent Cr_2O_3, but the concentrates that could be made from this ore would be high in iron. Other deposits of similar ore in the Big Bar Mountain area probably are too small and too difficult of access to be mined and concentrated under foreseeable economic conditions. Inasmuch as several relatively large deposits have been found in the ultramafic masses of the county, there is good reason to believe that further prospecting might lead to the discovery of other large deposits.

Mines and Prospects

Upper Butte Creek Area

Glenn Prospect (1)

J. W. Glenn did a little prospecting in 1941 on some small occurrences of chromite near the highway and hotel at Inskip on the east edge of the SE¼ sec. 29, T. 25 N., R. 4 E. The prospect apparently is the same as one called the Sourdough by George E. Sheldon during World War I. Several lenses of ore about 2 feet wide and a few feet long were mined in 1917. Averill reported that only a few tons of ore was in sight at the prospect in 1941. No shipments of ore from the property have been reported. (Averill 41)

Anti-Axis Claim (2)

The Anti-Axis chromite deposit is at an altitude of 2,100 feet on the west bank of Big Butte Creek in the SW¼SE¼ sec. 27, T. 24 N., R. 3 E. The property consists of one mining claim that was owned and operated in 1943 by F. H. Snow and Roy McClendon of Magalia. In March 1943 the deposit had been opened by a cut 75 feet long, 5 to 10 feet wide, and about 5 feet deep, and by a shallow cut that had not penetrated the overburden. Ore was trammed about 150 feet on a ground tram from the cuts to an ore bin at the end of the road. The operators planned to install a pump and pipe line to raise water from the creek for the purpose of sluicing the overburden around the cuts in an attempt to recover most of the float ore. They also planned to start a drift into the lower part of the lower cut. It is doubtful that these plans were carried out.

The deposit is only a few feet from the contact of highly sheared serpentine with metavolcanic rocks. The ore occurs as a series of small pods and thin stringers of chromite in a sheared zone that strikes about N. 60° W. and dips 70°-80° NE. in the serpentine. Most of the ore mined consisted of nearly massive chromite, but some pods had a little disseminated chromite on their borders. The low-grade material and adhering serpentine were hand-cobbed from the massive ore. The largest pod of ore found in the zone had a maximum thickness of about 3 feet and contained about 3 long tons of massive ore. Only 37 long tons of ore, containing 41.44 percent Cr_2O_3 and 10.84 percent Fe with a Cr to Fe ratio of 2.61, was shipped before the deposit was abandoned in 1943.

It is probable that the operators took out all the ore in sight, and the deposit does not offer much promise because of the small size and discontinuity of the ore bodies. (Rynearson 43)

Magalia Area

Lambert Mine (3) [21]

The largest deposit of massive chromite ore yet found in the ultramafic rocks of the northern Sierra Nevada occurs at the Lambert mine in the $SW\frac{1}{4}NW\frac{1}{4}$ sec. 2, T. 22 N., R. 3 E., about 2 miles southwest of the town of Magalia. The lowest workings of the mine are at the bottom of a canyon known as Carl Gulch, which is a branch of Little Butte Creek, and the main workings are several hundred feet higher, at an altitude of about 1,500 feet on the southeast side of the canyon. The upper workings are reached by $3\frac{1}{2}$ miles of dirt road from the paved highway near the Magalia Reservoir. This access road usually is made impassable to both trucks and passenger cars by heavy rains.

Chromite was discovered on the property when the Eureka Consolidated gold drift mine was opened in 1884, but no chromite was shipped from the mine until 1917-1918, when it was operated by the Union Chrome Co. under a lease from Nat Lambert. Although further attempts were made to find gold on the property, but little interest was taken in the chromite during the years between World Wars I and II. Early in 1943 M. V. Steifer and Frank Pestal obtained a lease from George Lambert and reopened the mine to look for more chromite. They mined chromite on a small scale until their lease ran out in 1945. R. F. Helmke, L. B. Thomas, and C. R. Janssen have leased and operated the mine since 1945. The Lambert mine is one of the few chromite mines in California that continued to operate after 1945. Ore was mined and shipped in 1946, 1947, 1949, and 1950, and the production from operations planned for 1951 should exceed that of any previous year.

This report on the Lambert mine is based mainly on the results of field work done by G. A. Rynearson in April 1943 and September 1949. The chromite deposits were studied in detail in 1949 and a map showing the geology and workings of the main part of the mine (pl. 15) was prepared with the assistance of F. L. Gilliland, the mine foreman. The underground workings have been considerably expanded since the mine was mapped. An attempt has been made to depict the recent workings from information furnished by the operators. The aid, information, and cooperation given by Mr. Steifer and Mr. Helmke and his associates during the course of this investigation are gratefully acknowledged.

The main workings of the mine consist of one large and two small open cuts and several thousand feet of underground openings extending eastward from four portals in the open cuts. The earliest of the workings are those leading from Portal I and part of those leading from Portal II. All the workings leading from Portal I and the easternmost of those leading from Portal II were not mapped because some have no significance with respect to the chromite deposits. Two pits opened in the bottom of the canyon in 1917 have been filled or covered by debris washed into the gulch. The ore mined during World War I was conveyed to the old road on top of the ridge by means of an overhead tram 1,120 feet long. Steifer and Pestal installed a new overhead tram 600 feet long from Portal I to the same road, to hoist the ore they mined. Helmke and his associates extended the old road from the top of the ridge to the large

open cut in 1945-46 and constructed a branch road to a point downhill from Portal IV early in 1950.

The geology of the area surrounding the mine has not been mapped in detail, but the general features are known. The ridges separating the larger canyons in the area are capped by a composite layer of Tertiary volcanic rocks several hundred feet thick. These volcanic rocks, most of which are tuffs, lie on a pre-volcanic erosion surface of rather low relief and dip gently southwest. The old land surface was developed on the upturned edges of a series of steeply dipping slates of the Calaveras formation and a sill-like mass of ultramafic rocks intrusive into the slates. Gold-bearing gravels were deposited along the courses of the larger streams that flowed on the pre-volcanic surface, but the small gully followed by the early underground workings of the mine is practically devoid of such gravel. The slopes of the gully, however, are covered with a mantle of soil, clay, talus, and miscellaneous detrital material several feet thick.

The sill-like mass of ultramafic rocks strikes northwest across Carl Gulch and dips steeply northeast. It is about a quarter of a mile wide in the vicinity of the mine, but may be somewhat wider where it crosses the canyon of Little Butte Creek to the southeast. The mass is covered by volcanic rocks southeast of Little Butte Creek, but its strike suggests possible continuity beneath the volcanic rocks with the northwest end of a long, narrow mass of ultramafic rocks exposed about 3½ miles southeast. The mass also may extend northwestward to Middle Butte Creek, as ultramafic rocks are said to crop out on its line of strike on the east side of that creek.

The original rocks of most parts of the ultramafic mass can be recognized with little difficulty, although they are almost completely altered to serpentine and further modified by shearing along numerous fractures. The bulk of the mass consists of saxonite, but many relatively small bodies of dunite are scattered through the saxonite. Although both types of rock are exposed in some underground workings of the mine, sufficient time was not available to map them separately. A few small dikes of rodingite occur along some fractures in the ultramafic rocks, and large dikes of granitic rocks crop out on the hillside several hundred feet southwest of the mine and near the bottom of the canyon northeast of the mine.

The original rocks along the margins of the ultramafic mass cannot be recognized, as they are completely serpentinized and sheared to slickentite. The mass is broken by many shear zones and minor faults, most of which strike and dip roughly parallel to the borders of the mass. Evidence of post-volcanic movement along some of these internal fractures can be seen in the underground workings of the mine where the contact between the volcanic and ultramafic rocks is offset by two or three faults having heaves of 3 to 6 feet or more. However, many shear zones and faults, including the shear zone that encloses the principal ore bodies, show no evidence of post-volcanic movement.

The main or upper workings of the mine have opened deposits of both primary and detrital chromite. The primary ore bodies occur as a series of large pods and small lenses and stringers of massive chromite in the central part of the ultramafic mass, along a prominent and well-defined shear zone that strikes about N. 30° W. and dips 70°-80° NE. At least

two of the larger primary ore bodies cropped out on the slopes of a shallow gully cut across the ore-bearing shear zone by pre-volcanic erosion. The outcrop of the largest of the ore bodies thus exposed was at least 60 feet long and as much as 20 feet wide. This ore body is one of the largest, if not the largest body of massive chromite that has been found in the ultramafic rocks of the Sierra Nevada. Nearly 1,500 long tons of ore has been mined from the uneroded portion of the body and at least 500 tons of ore still remains in the lower part and along the margins of the body. It is impossible to make a reliable estimate of the amount of ore eroded from the body, but the amount certainly exceeded 100 long tons. It is possible, therefore, that the original ore body may have contained as much as 2,500 long tons of ore. More than 900 long tons of ore has been mined from three or four smaller ore bodies in the shear zone, and one of these still may contain more than 100 tons of ore. Another ore body was discovered late in 1950 in a deeper part of the shear zone, but at this writing too little is known about its possible extent to judge its magnitude. Thus, the shear zone is known to encompass five or six sizable ore bodies, and it may contain others, as much favorable ground along the shear zone remains to be explored.

The detrital ore occurs as chunks of float chromite in the mantle of soil and clay that covers the old land surface beneath the volcanic rocks. The distribution of the float with respect to the outcrop of the ore-bearing shear zone and the contour of the ancient gully clearly indicates a derivation from the primary ore bodies that were exposed prior to being covered by the volcanic rocks. Most of the fragments of float chromite weigh no more than a few pounds apiece, but several that have been mined weighed more than 1,000 pounds and one weighed about 20 long tons.

According to Waring (17), two primary ore bodies occurring about 50 feet apart were mined in 1917 from the peridotite in the bottom of the canyon about 500 feet northwest of the main workings of the mine. One ore body had a strike of N. 30° W. and was 16 feet long, 8 feet wide near its center, and extended to a depth of more than 12 feet. The other body had a north strike and was mined from a pit 10 feet long, 6 feet wide, and 15 feet deep. The actual amounts of ore taken from these ore bodies are not known, but Waring's descriptions indicate that either or both bodies may have yielded as much as 100 long tons of ore. Little evidence of the old workings could be found in 1949, but their approximate location was ascertained. Any possibility that the lower ore bodies constitute a part or an extension of the upper deposit seems to be precluded by their relative remoteness as well as by their relative location, which apparently is somewhat west of a possible northwestward extension of the ore-bearing shear zone in the upper workings.

As noted previously, the earliest workings of the mine were made in a search for gold-bearing gravels. The first operators evidently found traces of gold at the outcrop of the bed of the gully eroded on the pre-volcanic surface and started to follow the gully eastward from Portal II in the hope of finding gold-bearing gravels along its course. Some pieces of float chromite also may have been noted near the outcrop of the bed of the gully, but chromite was not discovered in place until the adit crossed the shear zone about 40 feet east of the portal. Subsequent underground work by the early operators also disclosed the presence of large amounts of float chromite in the soil and clay on the old land sur-

face east of the shear zone. Apparently no attempt was made to mine the ore until World War I, when high prices were offered for chromite. During 1917-18 more than 600 long tons of ore was mined from stopes A and B and more than 30 tons of chromite was recovered from the detrital deposit. In addition, perhaps as much as 200 long tons of ore was mined from the ore bodies in the bottom of the canyon.

Many parts of the old workings were flooded or backfilled when Steifer reopened the mine in 1943. Consequently, his early operations were concentrated on the mining of detrital chromite from the labyrinth of workings in the southeastern part of the mine. He had recovered between 60 and 70 long tons of float chromite by early 1944, when his efforts to trace the richest concentrations of float led him to discover the large ore body. He mined a little less than 60 long tons of ore from the large ore body before his lease expired later in 1945.

The subsequent lessees mined 1,070 long tons of ore from stope C in 1946 and 1947, but had to abandon the stope in 1947 because of the difficulties involved in keeping it drained and open and because of the problems encountered in tramming the ore through the irregular old workings to Portal II. An adit was driven from Portal III to the lower end of the large ore body in 1949, and about 300 tons of ore was mined from stope D during 1949-50. After stope C had been cleaned out through an opening from stope D, the operators found and mined a slab of ore that had been overlooked previously because it was separated from the footwall of the main body of ore by a septum of sheared serpentine. Late in 1950 the floor of stope C was in ore from wall to wall and most of the back and floor of stope D was in ore also.

A short crosscut branching from the adit from Portal III cut another ore body in the shear zone between stopes B and D. About 300 tons of the ore in this body was mined from stope E in 1950, and considerable ore remained in the back and floor of the stope at the end of the year. Although this ore body apparently pinches out near the northwest end of stope E, it may be connected by a narrow stringer of ore to the remnants of the ore body taken from stope B. The ore seems to be continuous from stope E to stope C, but the ore in stope D is so shattered and mixed with serpentine that the true relationship of the two ore bodies cannot be ascertained, at least not from the evidence disclosed by the present workings. Nevertheless, the two bodies appear to be in contact and may have been connected at one time. Now, however, the southeast end of the smaller ore body apparently overlaps the northwest end of the large ore body and original connection probably has been broken.

The adit from Portal IV was driven at some time during the interval between World Wars I and II in the hope of finding a gold-quartz vein at depth along one of the faults that earlier operators had exposed in the eastern part of the uppermost workings. No quartz veins were found, but the adit cut across the shear zone that contains the ore bodies found in the workings above. No evidence of any chromite could be seen in the shear zone in the adit in 1943, but between 1943 and 1949 a large block of the sheared serpentine fell from the back of the adit and disclosed a small stringer of chromite, which indicated that ore was present in the shear zone to at least the level of the adit. After the geometry and geology of the workings and of the known ore bodies were mapped in 1949 it became apparent that further exploration and development could

be accomplished most efficiently by drifting along the shear zone from the lower adit. Work was begun on the new development program in the summer of 1950, and by the time this report was being prepared a new drift had been driven along the shear zone to a point about 20 feet southeast of the adit. This drift uncovered another ore body, which was 6 inches wide 10 feet from the adit, and 3 feet wide 20 feet from the adit. Furthermore, test holes drilled at diverging angles into the face of the drift indicated that the ore body was at least 6 feet wide a few feet southeast of the face. Although the magnitude of this ore body is not yet known, the discovery of a sizable ore body so deep in the shear zone adds materially to the area that can be considered favorable for further exploration.

The bulk of the ore in the Lambert ore bodies is the massive type, and much of the chromite is rather coarse grained. The chromite in some small lenses and stringers has been sheared to comminuted but compact and cohesive masses, and the ore in some parts of the larger ore bodies is highly fractured and diluted with admixed serpentine. No analyses have been made of the pure chromite, but some analytical data are available for the mine-run ore. All the available data, however, are for ore taken from the large ore body in stopes C and D or for detrital ore eroded from this ore body. The partial analysis given in table 2 probably is typical of most of the ore in the deposit. The ore is particularly good for use as a refractory material because the amounts of iron and silicia in the ore are relatively low and the amounts of alumina and magnesia are correspondingly high. The ore shipped by Steifer during 1943-44 averaged 42.26 percent of Cr_2O_3 and 9.77 percent Fe, with an average Cr to Fe ratio of 2.96. Small assay-lots of this ore contained 40.61 to 44.83 percent Cr_2O_3 and 9.35 to 10.19 percent Fe, and the Cr to Fe ratios ranged from 2.81 to 3.22. The differences in the tenors of the various lots probably can be attributed mainly to unequal dilution by serpentine that occurs as seams along fractures in the ore. The ore shipped by Helmke during 1946-50 has also averaged about 42 percent Cr_2O_3.

Federal records credit the Lambert mine with the production of 537 long tons of ore in 1917 and 379 tons in 1918. The production reports submitted by the operators during World War I probably include some ore from other deposits worked by them, for George Lambert, the present owner and son of the former owner, claims the Lambert mine yielded only 961 short tons or 857 long tons of ore during 1917-18. The mine yielded 54 long tons of ore in 1943; 48 tons in 1944; 22 tons in 1945; 854 tons in 1946; 216 tons in 1947; 152 tons in 1949; and 490 tons in 1950, including about 130 tons of broken ore stocked at the end of the year. The total production of the mine to the end of 1950 amounts to approximately 2,700 long tons of ore.

As is the case with nearly all deposits of massive chromite ores for which only two dimensions are known or indicated, it is impossible to make an accurate estimate of the reserves of the Lambert mine. Ore is exposed at several places in the workings, but the amount of ore these exposures represent cannot be foretold. It would appear, however, that the large ore body opened by stopes C and D still contains at least 500 long tons of ore and the ore body opened by stope E may contain more than 100 tons of ore. Approximately half of the original area known to

contain detrital ore has been mined already. This half yielded about 100 long tons of ore and probably represents the richest portion. The unmined half probably is not more than half as rich, and the chromite fragments in it are probably smaller. It is unlikely, therefore, that more than 50 long tons of chromite remains in the known parts of the detrital deposit. At this writing too little is known about the extent of the ore body encountered in the new drift from the lower adit to make any estimate of the amount of ore it may hold.

Inasmuch as the unexplored segments of the shear zone adjacent to the known ore bodies might well contain other large ore bodies, it is conceivable that the potential reserves of the deposit could equal the tonnage of the past production. Chromite has been found at or just below the "outcrop" of the shear zone from the northwest end of stope A to the southeast end of stope C, a distance of approximately 215 feet, and the new drift from the adit from Portal IV has proved that ore in quantity occurs in the shear zone to at least the level of this adit. Thus, that part of the shear zone above the level of the lower adit and between the extremities of stopes A and C appears to be the most favorable block of ground for additional exploration. The operators contemplate thorough exploration of the block from drifts to be driven southeast and northwest from the lower adit. Diamond-drilling does not seem warranted at the present stage of development. However, if it is found that much ore extends more than a few feet below the floors of the exploratory drifts, deeper exploration may require several diamond-drill holes. These holes could be drilled from a station in the adit east of the shear zone.

Further exploration along or just below the "outcrop" of the shear zone northwest of stope A and southeast of stope C should be undertaken at an early stage in order to define the total near-surface length of the deposit. The floors of the old workings from Portal I are in volcanic material a few feet above the old land surface, but shallow pits could be dug or test holes could be drilled to the shear zone from these workings to prove or disprove the possible presence of ore northwest of stope A. Exploration southeast of stope C is justified because the contour of the old land surface indicates that the detrital chromite in the southernmost workings may have come from a source about 25 feet southeast of the stope.

It should be noted that the width of the shear zone is not uniform from one place to another. Recognition of this inconstancy may lead to the discovery of small ore bodies that otherwise might be passed by. In parts of stope A the sheared zone may be less than 10 feet wide, but in stope C it is at least 25 feet wide, and in the lower adit it is about 15 feet wide. An ore body may occur anywhere within the margins of the shear zone, and it is possible for two ore bodies to occur side by side, separated by a septum of sheared serpentine. This situation is illustrated by the slab of ore found in the footwall of the large ore body in stope C. Small bodies like this slab can be overlooked unless test holes are drilled through the sheared serpentine into solid rock at frequent intervals throughout the workings. The top of the ore body in stope E or even the large ore body in stope C might have been discovered in 1918 if a few test holes had been drilled from the old drift between stopes B and C. (Rynearson 43, 49; Bradley 18; Waring 17; Lindgren 11; Miner 90)

Christian Place (4)

A chromite deposit on property known as the Christian Place was operated in 1943 by A. M. Glover and R. Parkeson under a lease from R. E. Miller of Yankee Hill. The workings are at an altitude of about 3,100 feet in the NE¼NE¼ sec. 32, T. 23 N., R. 4 E., about three-quarters of a mile east of Sawmill Peak. Exploitation of the deposit was in the initial stages when the writer visited the property in April 1943. Several shallow trenches and two shallow shafts, none of which had penetrated the thick overburden of red clay and soil, were the only workings at that time.

All the ore found in the early operations occurred as irregular masses in the red clay and soil, which was derived from the weathering of the serpentine in place. The alignment of the main workings appears to indicate a discontinuous ore zone trending N. 75° W. for a distance of at least 150 feet. A little ore found about 50 feet down the hillside may indicate another ore zone. About 10 long tons of ore had been mined and was on the dumps when the deposit was visited. Ore said to be present in the bottoms of the workings was concealed by mud washed in by the spring rains. The deposit yielded 31.4 long tons of ore containing 52.97 percent Cr_2O_3 and 12.17 percent Fe with a Cr to Fe ratio of 2.98. It is assumed that the deposit was worked out during 1943. (Rynearson 43)

Parkeson Claim (5)

A. M. Glover and (?) R. Parkeson opened a chromite deposit on the Parkeson claim in the SE¼(?) SE¼ sec. 20, T. 23 N., R. 4 E. They shipped 31.4 long tons of ore containing 41.27 percent Cr_2O_3 and 11.82 percent Fe with a Cr to Fe ratio of 2.39 from the deposit in 1943. No other information concerning this deposit is available.

Pulga Area

Simmons (6)

A chromite deposit in sec. 26, T. 23 N., R. 4 E., was discovered in 1916 or 1917 by D. B. Simmons, who apparently located two claims called the Nevera and Sunnyslope. Although one report specified the location of the deposit as being in the NW¼SE¼ of the section, Waring's description with respect to topography and the direction from the Section 35 deposit would indicate the location to be in the S½SW¼ of the section. Because of confusion over the actual section location, F. W. Stewart mined and shipped some ore from the deposit in 1917 before the parties concerned found that the deposit was in sec. 26 on open ground and not on railroad land in sec. 35, a part of which was under lease to Stewart. Simmons reported that he sold (leased?) his interests in the property to L. R. Stokes in 1918. The only workings consisted of a shaft and a tunnel.

Waring reported 71 long tons of ore mined and on the property in July 1917. As Stewart shipped 46.3 long tons of this ore in November 1917, the 27-ton production reported by Simmons for 1917 probably represented the remainder of the mined ore reported by Waring. Both Simmons and Stokes reported an identical production figure for 1918—31 long tons of ore containing 35.86 percent Cr_2O_3—and it is probable that the two reports represented the same ore, although it is not known whether they represent ore mined in 1918 or merely the shipment of the ore reported by Simmons in 1917. (Southern Pacific Land Co. 49; Waring 17)

Section 35 Mine (7)

The Section 35 mine is located in the southwest corner of the SW¼NE¼ sec. 35, T. 23 N., R. 4 E., about three-quarters of a mile by narrow truck-trail west of the county road between Concow and Flea Valley. The property was owned by the Southern Pacific Land Co. in 1949. Mining leases on the SW¼NE¼ and NW¼SE¼ of the section were made to F. H. Stewart and W. A. T. Agard during 1916-19 and to Mrs. Lillian Graham and J. R. King during 1942-43. The mine was operated by Stewart in 1916 and 1917 and by W. H. King in 1918 on an assignment from Stewart. No mining has been done since 1918. The main workings consist of an open cut 30 feet wide and 40 feet long, a drift at least 20 feet long from the face of the cut, and a shaft or underhand stope about 25 feet deep in the floor of the drift. The underground workings are flooded. A small prospect cut was made about 70 feet northwestward from the main cut.

The country rock in the vicinity of the mine consists largely of relatively unaltered saxonite, which encloses small masses of dunite. One of these dunite masses contains the ore zone, which strikes north to N. 25° W. and dips steeply southwest. If the narrow band of disseminated ore in the prospect cut is a continuation of the ore zone in the main workings, the zone is at least 100 feet and perhaps as much as 120 feet long.

The ore in the zone consists of pods and stringers of nearly massive ore and of bands and streaks of several types of disseminated ore. Some of the disseminated ore exhibits structures similar to those found in the ore at the Fairview mine in Siskiyou County (Wells, F. G., 49). A little of the ore is of the rare type in which small ellipsoidal or lenticular masses of olivine occur in an olivine matrix containing sparsely disseminated chromite.

When Waring visited the property in 1917 one pod of ore containing 45 to 50 percent Cr_2O_3 had been worked to a depth of 18 feet, where it was 30 inches wide and 10 feet long and appeared to be widening out. This ore body had a maximum length of 20 feet and a maximum width of 5 feet. Its strike was N. 15° W. Approximately 2 long tons of disseminated ore containing about 28 percent Cr_2O_3 had been mined at the south end of the body. Inasmuch as Waring did not mention any underground workings at that time, the ore taken later from the drift and shaft may have come from a second ore body.

Stewart shipped 137 long tons of ore from the deposit in 1917 and King shipped 64 tons in 1918. A little massive ore remains in the back of the drift, but it probably is only a thin slab representing the top of an ore body already mined. About 2 long tons of shipping-grade ore is scattered about the deposit, and several tons of similar ore probably could be recovered from the dump. The amount of disseminated ore indicated is not large enough to justify even a small concentration plant. (Southern Pacific Land Co. 49; Rynearson 43; Bradley 18; Waring 17)

Lucky Bill (8)

W. H. King opened the Lucky Bill and an adjoining unnamed chromite deposit in the SW¼NE¼ sec. 36, T. 23 N., R. 4 E., during World War I. The deposits were worked from two open cuts and yielded approximately 45 long tons of ore. No ore remains in the workings. (Rynearson 49)

Twin Cedars Claims (9)

G. C. Rohrer and Jess McCrosky located the Twin Cedars claims in 1917 in the $SE\frac{1}{4}$ sec. 36, T. 23 N., R. 4 E. One lenticular ore body with a north strike was opened by an open cut and yielded 20 long tons of rather low grade shipping ore. No ore remains (Bradley 18; Waring 17)

King Prospects (10, 15, 16)

W. H. King leased parts of sec. 1, T. 22 N., R. 4 E., from the Central Pacific Railroad Co. in 1918. The Southern Pacific Land Co., which acquired the section at a later date, sold the entire section in 1948 to Jack and Bettie Lou Koterske of Hynes, Calif. King mined and shipped 7.2 long tons of ore from two small prospects in the $N\frac{1}{2}NE\frac{1}{4}$ of the section in 1918.

Another chromite prospect in the $NW\frac{1}{4}$ sec. 32, T. 23 N., R. 5 E., yielded 10 long tons of ore to King in 1918. A small open cut was made in extracting the ore.

King and one of his sons found some promising float in the $NW\frac{1}{4}NE\frac{1}{4}$ sec. 6, T. 22 N., R. 5 E., but did not locate its source. No workings have been made in this area.

Stewart Mine (12)

The Stewart chromite mine, as it is known locally, is located just east of the road in the southwestern part of the $SE\frac{1}{4}NE\frac{1}{4}$ sec. 1, T. 22 N., R. 4 E. F. H. Stewart, W. A. T. Agard, and A. E. Almind leased the property and operated the mine during 1916-17. They shipped 126 long tons of ore containing about 52 percent Cr_2O_3 in 1916, but it is not known how much ore, if any, was shipped in 1917. Waring reported that the deposit had been worked out and abandoned by July 1917. (Southern Pacific Land Co. 49; Waring 17)

Reynolds No. 1 (13)

About a quarter of a mile east (southeast?) of the Stewart mine is another deposit known as the Reynolds mine, here called the Reynolds No. 1 deposit to distinguish it from another bearing Reynolds' name. The No. 1 deposit is near the line between the $SE\frac{1}{4}NE\frac{1}{4}$ and the $NE\frac{1}{4}SE\frac{1}{4}$ of sec. 1, T. 22 N., R. 4 E. The workings, now flooded, consist of a shaft about 75 feet deep with some short drifts at the bottom. W. H. King mined and shipped about 35 long tons of ore from the deposit in 1918, but the total amount of ore taken from the workings is not known. It is possible that F. H. Stewart et al. and L. R. Stokes may have mined some ore from the deposit also. According to J. H. Brassell, 6 or 7 tons of ore remained on the dump in 1943. (Rynearson 49)

Stokes Prospects (11)

L. R. Stokes leased the $NE\frac{1}{4}SW\frac{1}{4}$ sec. 1, T. 22 N., R. 4 E., in 1918 and mined 4 long tons of ore from one small prospect. He also leased the $SE\frac{1}{4}NE\frac{1}{4}$ of the section in 1918 and shipped 4 long tons of ore from one deposit there. He may have obtained this ore from the abandoned Stewart mine, however. (Southern Pacific Land Co. 49)

Reynolds No. 2 (14)

A Mr. Reynolds mined some chromite from a deposit between the highway and the river near Cold Springs Gulch in the $NE\frac{1}{4}SE\frac{1}{4}$ sec. 6, T. 22 N., R. 5 E., during World War I. It is not known how much ore he took from the deposit, but no ore remains. (Rynearson 49)

Big Bar Mountain Area
Little Hope (17) and Mary Jane (19) Claims

J. H. Brassell of Pulga owned and operated a chromite deposit in the NW¼ sec. 5, T. 22 N., R. 5 E., during 1942-43. The workings at this deposit are east of the Oroville-Quincy highway, a little north of the bridge over the North Fork of the Feather River. The property consisted of one mining claim named the Little Hope when the writer made his examination in April 1943. A later report by the Metals Reserve Co. agent at Oroville gives the Mary Jane claim in sec. 31, T. 23 N., R. 6 E., as the source of all the ore shipped by Mr. Brassell. This discrepancy in names probably is the result of shipments being made from two separate deposits. The analyses of Brassell's last two shipments of ore show much higher percentages of Fe than his previous shipments, an indication that the last shipments came wholly or partly from another deposit. Mr. Brassell told the writer of several other prospects on another property in sec. 5 adjoining the Little Hope. Only a little work had been done on these prospects, however.

When the Little Hope deposit was visited it had been opened by an open cut 25 feet long, 5 to 15 feet wide, and 5 to 15 feet deep; a drift 15 feet long from the face of the cut; and a small prospect pit. A gravity ground tram was used to transport the ore from the workings to a loading chute on the edge of the highway.

The ore occurred in serpentinized and talcose dunite in a large mass of ultramafic rocks. Exposures are scarce in the vicinity, and the size and shape of the dunite mass could not be determined. Much of the country rock is highly fractured, and it is possible that the main workings on the claim are in a landslide block. The ore body mined from the cut and drift consisted of an irregular pod of massive chromite 1 to 15 feet wide. In the cut it dipped gently south with a trend of N. 80° E., but in the drift it trended southeast. About 5 tons of ore had been mined from another ore body about 200 feet southeast of the main workings and about 80 feet higher on the hillside. This body was 20 inches wide, but its length and depth had not been delimited.

Mr. Brassell shipped 22.4 long tons of ore to the Quincy stockpile in 1942 and 73.7 tons to the Oroville stockpile in 1943 and 29.6 tons in 1944. Six lots of this ore, aggregating 84.8 long tons, gave similar assays that averaged 41.15 percent Cr_2O_3 and 11.18 percent of Fe with an average Cr to Fe ratio of 2.52; most of the ore in these lots probably came from the Little Hope claim. Two lots, aggregating 40.9 long tons, averaged 36.83 percent Cr_2O_3 and 12.78 percent Fe, with a Cr to Fe ratio of 1.97; this ore may have come partly from the Little Hope claim and partly from the Mary Jane claim, as suggested above. No information is available on which estimates of the possible reserves of these deposits might be based. (Rynearson 43)

Big Pine Claim (18)

A chromite deposit on Mill Creek in the SE¼ sec. 34, T. 23 N., R. 5 E., was relocated by J. H. Brassell during World War II as the Big Pine claim. The deposit is reached by about a mile of steep trail from the road to Big Bar Mountain. According to Mr. Brassell, 200 to 250 long tons of ore was mined from the deposit during World War I (by J. G. Dwyer?), but none of the ore was shipped. The workings consist of an open cut and a shaft 20 feet deep, which now is flooded. The ore is of the

disseminated type, and samples that have been analyzed contained 28 to 36 percent of Cr_2O_3. The Cr to Fe ratio is not known. Mr. Brassell estimated that the deposit might yield several thousand tons of milling-grade ore, but he also thought the reserves probably would not be large enough to justify the construction of an access road and a concentration plant. (Rynearson 43)

War Bond Group (20-23)

J. A. Clark of Yankee Hill located the War Bond group of chromite claims during the early part of World War II. The group included three claims in sec. 1, four claims in sec. 2, and four claims in sec. 12, T. 22 N., R. 5 E. These claims probably covered the same deposits as several earlier claims known as the Liberty group, which were held by John Wells, R. S. Pollack, and B. F. Clark during World War I. According to J. A. Clark, a few small pits were dug on the claims and float was found at several places. However, all the chromite occurrences proved to be rather small and the ore was poor in quality. Nevertheless, some ore containing about 35 percent Cr_2O_3 was shipped from the claims in 1918. B. F. Clark reported that he shipped 45 long tons of ore in 1918, and it is assumed his report represented the 1918 production from the Liberty claims. John Wells made separate reports of the shipment of larger amounts of ore, but most if not all of the ore reported by Wells probably came from another deposit that he worked in the Yankee Hill area (see under Green Ridge claim). (Rynearson 43; Thompson 18)

Section 13 (24)

A deposit of disseminated chromite in the Big Bar Mountain area was examined by Averill in 1941. This deposit is on a ridge between French and Haphazard Creeks, probably in the NE¼ sec. 13, T. 22 N., R. 5 E. Assuming the section location given above is correct, the deposit is in a section purchased by J. K. Mezker of Oroville in 1946 from the Southern Pacific Land Co. It is said that two carloads of ore from the deposit was packed out 14 miles on burros to the railroad and shipped during World War I.

According to Averill, considerable disseminated ore, containing 20 to 30 percent Cr_2O_3, shows in an open cut 30 feet wide and 10 feet deep and along the ridge in both directions along the strike of the ore body from the cut. He thought the ore zone might be as much as 30 feet wide, 100 feet long, and 10 feet deep. If these dimensions are representative of the actual size of the zone, the deposit could contain as much as 2,500 long tons of milling-grade ore. (Southern Pacific Land Co. 49; Averill 41)

Swayne Mine (25) [22]

The Swayne mine is located in the NE¼ sec. 9, T. 22 N., R. 5 E., on a low saddle east of Big Bar Mountain. The property was owned by the Swayne Lumber Co. during World War I. A. H. Noyes worked the deposit in 1917 for V. V. Apperson, who held a lease at that time. A. E. Brune, L. D. Logan, and A. L. Wakeham leased and operated the property in 1918. No chromite has been mined on the property since 1918. The workings consisted of an open cut having a length of 150 feet, a maximum width of 16 feet, and a depth of 25 feet, and a winze 16 feet deep in the bottom of the cut. An adit was started to connect with the winze, but it is not known if the connection was completed.

The ore in the deposit was of the planar-banded type, containing 30 to 34 percent Cr_2O_3. The strike of the chromite layers was northwest and the dip nearly vertical. Although some reports indicate that the mine yielded between 1,200 and 1,400 long tons of ore, Federal and State records show the production to be 350 long tons in 1917 and 503 tons in 1918. The deposit was reported to be worked out by September 1918. (Louderback 18; Thompson 18; Bradley 18)

Liberty Bond Claim (26)

J. C. Akin opened a chromite deposit in 1918 on his Liberty Bond claim in the $SW\frac{1}{4}$ sec. 8, T. 22 N., R. 5 E. He mined about 33 long tons of ore containing 28 percent Cr_2O_3 and piled it alongside the Western Pacific Railroad. He also had about 10 tons of richer ore on the hillside above that he intended to use to sweeten the lower-grade ore, but his intentions never were carried out and none of the ore has been shipped.

War Eagle (36) and Miller (34, 35) Deposits

The War Eagle and Miller chromite deposits are on adjacent properties on the east side of the North Fork of the Feather River. The War Eagle is at an altitude of about 1,700 feet in the $NE\frac{1}{4}NW\frac{1}{4}$ sec. 31, T. 22 N., R. 5 E. The section is owned by the Southern Pacific Land Co. and a 40-acre lease was held by B. D. Krumlauf of Spokane, Washington, in 1941. The Miller consists of two claims (also known as Mountain of Chrome claims?) in the $SE\frac{1}{4}SW\frac{1}{4}$ and the $SW\frac{1}{4}SE\frac{1}{4}$ of sec. 30, which were relocated by R. E. Miller during World War II. Both properties are known locally as the War Eagle or Clark Chrome mine, so called because J. A. Clark of Yankee Hill is supposed to have discovered and prospected them during World War I. Two small open cuts on the War Eagle and four shallow trenches on the Miller constituted the only workings made prior to 1941. These workings are from 600 to 700 feet higher than the tracks of the Western Pacific Railroad, which are about 100 feet higher than the river. The nearest road is across the river from Intake, a station on the railroad 1 mile down the river. Another road, also across the river, terminates at a cable crossing 3 miles up the river.

The largest of the deposits is the War Eagle. It consists of a zone of fine-grained disseminated ore that can be traced by outcrops and float for a distance of about 400 feet through a vertical range of about 150 or 200 feet. A diorite dike may cut the zone off at its eastern end. The zone strikes northeast and dips about 60° SE. One of the cuts exposes about 5 feet of the zone's thickness, but the actual thickness is probably 10 feet or more. The zone is enclosed by a mass of thoroughly serpentinized and talcose dunite. The rocks may be partly silicified also. The altered dunite is enclosed by similarly altered saxonite, which crops out near the crest of a small ridge about 100 feet southeast of the ore zone.

Disseminated ore is exposed in three of the four trenches on the Miller claims. The ore occurs as small lenses in a zone that is not likely to be more extensive than shown in the trenches, and it appears that only a few tons of low-grade ore is present in the zone.

Two samples of the ore from the War Eagle ore zone were analyzed by the Rustless Mining Corp. and found to contain 29.81 and 27.99 percent Cr_2O_3 and 11.66 and 12.84 percent Fe, respectively. Panned concentrates of the same samples contained 42.45 and 42.40 percent Cr_2O_3 and 15.50 and 14.90 percent Fe, with Cr to Fe ratios of 1.88 and 1.93. These

samples were higher in tenor than the average ore in the deposit, which probably contains only 10 to 15 percent Cr_2O_3.

Although the War Eagle ore zone has not been prospected well enough to permit the making of definite conclusions regarding its extent, it appears to be a well-developed zone and is probably continuous for at least 400 feet along the strike. If it is assumed that the zone has an average thickness of 5 feet, a length of 400 feet, and a depth of 200 feet at its southeast end, reserves of 20,000 long tons of milling-grade ore can be inferred. Additional trenching across the zone at frequent intervals may show the average thickness of the ore to be somewhat greater than assumed above, and thus increase the amount of reserves that can be inferred.

Inasmuch as the ore zone has a rather steep dip and a strike into the ridge, conditions for underground mining are quite favorable. A suitable mill site is available on a small flat a little above the railroad, and power is available from a power line about half a mile across the river. Nevertheless, the low Cr to Fe ratio indicated for concentrates made from the ore has discouraged prospective operators, and no ore has been shipped from the deposit. (Rynearson 41; Thompson 18)

River Side Claim (37)

The River Side claim in the NW¼ sec. 32, T. 22 N., R. 5 E., was owned and operated by J. C. Akin in 1943. He shipped 10 long tons of ore from the claim in a mixed lot to the Oroville stockpile. According to Mr. Akin, the ore was mined from surface workings and none was left in the deposit when he abandoned the claim.

Miscellaneous Deposits

Several other deposits were worked or prospected in the Big Bar Mountain area during World War I. However, the low grade of most of the ores and the long packing distances to a shipping point discouraged the operators from exploiting the deposits very extensively. Edwin Barnham and Harry Edwards claimed at least three of the deposits in Happy Hollow on French Creek, T. 22 N., R. 5 E., but the section locations of their claims are not known. They reported that they shipped about 90 long tons of ore from the April Fool claim in 1918 and left about 18 tons on the dump. Barnham reported that about 16 long tons of ore was mined but not shipped from the Dorothy claim. Edwards reported that about 50 long tons of ore was mined from a deposit on the Big Wonder claim and that about 37 tons of this ore was packed part of the way to the railroad. J. C. Akin informed the writer that in 1949 this ore still was near the trail in the S½ sec. 25, T. 22 N., R. 5 E., near a new Forest Service road. The ore sold by Barnham and Edwards was brought and shipped by G. O. Dowden, who also bought and shipped the ore mined from other deposits in the general region. Dowden's reports to the California Division of Mines are somewhat confusing with regard to the amounts of ore he actually shipped, but the total amount probably was between 150 and 200 long tons.

Yankee Hill Area

Hendricks Prospect (27)

According to Mrs. E. D. Hendricks of Concow, a small chromite deposit on the east edge of the SE¼ sec. 27, T. 22 N., R. 4 E., was prospected during World War I. About one ton of ore was mined at that time, but no work has been done since. (Rynearson 49)

Lockridge Property (28)

A small chromite deposit was opened during World War I in the southeast corner of the NE¼SE¼ sec. 28, T. 22 N., R. 4 E. The property was owned by J. D. Lockridge in 1949. A little chromite was taken from a trench 3 feet wide, 20 feet long, and about 3 feet deep. Apparently the ore occurred as a narrow stringer or as a series of very small lenses along a narrow shear zone in serpentinized dunite. The shear zone strikes N. 58° W. and dips about 80° NE. The bottom of the trench is filled with waste rock, and no ore can be seen in place. One relatively large piece of ore on the dump is about 8 inches thick, with serpentine frozen to the original walls. Less than one ton of ore in small fragments remains on the dump. It is not known how much ore, if any, was shipped from the prospect. (Rynearson 49)

Hendricks No. 1 (29)

Several previous reports refer to a Hendricks chromite mine in the Yankee Hill area, but the locations given for the mine differ widely. Waring (17) mentions two deposits bearing the Hendricks name, and it is assumed that the early references are to two distinct deposits, which will be described in this report as the Hendricks No. 1 and the Hendricks No. 2 deposits. Local inhabitants were unable to tell the writer just where either deposit is located, so neither one was visited.

The Hendricks No. 1 deposit, according to Waring, is located somewhere in sec. 34, T. 22 N., R. 4 E., about a mile east of Yankee Hill. Charles and William Hendricks owned the property in 1917 and leased it to Mr. Cashom and Mr. Alexander of the Western Ores Co. The workings made on the deposit consisted of an open cut 100 feet long, 5 feet wide, and 20 feet deep, and a winze 14 feet deep near the center of the cut.

Waring's July 1917 report described the ore body as being lentiecular, 40 feet long, and tapering from a thickness of 5 feet at the center to a point at either end. Its strike was N. 45° W. and its dip 80° NE. The ore body apparently pinched out at a maximum depth of 30 feet below the surface. Waring described the ore as being "mottled," with considerable serpentine frozen to it. About 45 long tons of the ore had been mined and was ready for shipment by July 1917, but Waring's report does not indicate whether more ore remained in the workings. Neither the tenor nor the total amount of ore shipped from the deposit are known. (Bradley 18; Waring 17)

Green Ridge Claim (30)

The Green Ridge claim was located by Loren Babcock in 1949 on a chromite deposit near the county road in the SE¼NW¼ sec. 4, T. 21 N., R. 4 E. The property was known previously as the Dynamite Kid or Wells mine and was owned and operated by John Wells during World War I. The workings consist of two open cuts, the bottoms of which now are filled with waste rock. The largest of these cuts is an irregular opening about 80 feet long, 3 to 20 feet wide, and 4 to 10 feet deep. An adit may have existed beneath the cut at one time, but it is caved now. The smaller cut is about 15 feet southeast of the main cut and is 35 feet long, 3 to 6 feet wide, and 3 to 5 feet deep.

The deposit occurs in a small serpentine mass 300 to 400 feet wide and about half a mile long. The serpentine is the highly sheared "slickentite"

variety, and a small quarry near the chromite deposit was made in excavating the material for road metal.

Thompson described the main ore body as being tabular in shape and said it was 60 feet long, 2 feet wide, and 15 feet deep. He indicated that some ore remained in the bottom of the cut, but the only ore that could be seen in place in the workings in 1949 was a small stringer of spotty ore 8 inches wide near the face of the cut. The strike of the main part of the cut, and presumably the strike of the ore body, is N. 48° W. and the dip is 80° NE. State records for 1918 credit Wells with the production of 125 long tons of ore containing about 35 percent Cr_2O_3, whereas Federal records credit him with only 94 long tons. Perhaps the larger figure includes some ore produced from the Liberty claims in the Big Bar Mountain area. No ore has been shipped from the Green Ridge deposit since 1918. (Rynearson 49; Louderback 18; Thompson 18)

Hendricks No. 2 (31)

Waring (17) reported that William Hendricks had mined about 27 long tons of ore in 1917 from a deposit near Cape Horn in sec. 6 (NE¼?), T. 21 N., R. 4 E. The ore reportedly contained about 38 percent Cr_2O_3, but it had not been shipped because there was no road to the deposit. It is assumed that this deposit represents the Hendricks mine visited by Thompson (18) in July 1918. At that time the Western Ores Co. was concentrating the disseminated ore from the deposit in a small mill on the property. The company's mine workings consisted of an open cut and an adit 120 feet long ending in a short raise to the open cut.

Thompson's report indicates that the deposit consisted of a zone of disseminated ore from 2 to 10 feet wide, which had been opened for 100 feet along the strike and for 50 feet in depth. He reported the strike of the zone to be northwest and the dip almost vertical. The mill was being fed with ore containing about 10 percent Cr_2O_3, and about 80 long tons of concentrate had been made. Thompson estimated the reserves to be 500 to 1,000 long tons of ore containing about 10 percent Cr_2O_3. This estimate evidently was of the right order, for the deposit was abandoned and the mill was moved to the Taylor property sometime between July and September 1918. The company reported its 1918 production to be 143 long tons of chromite concentrate; most of the concentrate produced probably was made from the ore of the Hendricks No. 2 deposit, but a little may have been from the Taylor deposit. (Diller 20; Louderback 18; Thompson 18; Bradley 18; Waring 17)

Taylor Property (32)

George Taylor owned a deposit of disseminated chromite in the SE¼ sec. 6, T. 21 N., R. 4 E., during World War I. He may have called this deposit The Gray Boy. The Western Ores Co. moved its mill from the Hendricks No. 2 property to the Taylor property late in 1918. Louderback's report indicated that but little work had been done on the Taylor deposit by September 1918 and the reserves were estimated to be 200 to 400 tons of ore containing 8 to 15 percent Cr_2O_3. Some concentrate was made from the ore, but neither the amount made nor the amount shipped, if any, is known. Averill reported a few tons of concentrate was piled on the property in 1942. (Averill 42; Louderback 18)

Park's Ranch Mine (33) [24]

The Park's Ranch chromite deposit, also known as the Lime Saddle, Iron Point, or Curtis mine, is at an altitude of about 1,100 feet in the $S\frac{1}{2}NE\frac{1}{4}$ sec. 7, T. 21 N., R. 4 E. J. G. Curtis owned the property during World War I and leased to John Marchant in 1916-17 and to a Mr. Cashom in 1918. T. W. S. Clark, I. H. Reimers, C. M. McNallen, and A. Stevenson leased the property in 1942 from Frank H. Park, the present owner. The workings consist of a large open cut; and adit about 85 feet long leading to a stope that opens into the cut 35 feet above the track level; a raise to the surface, another short raise, a winze 25 feet deep, and a stope reaching almost to the surface, all of which originate from a point in the adit 45 to 50 feet from the portal; and a shaft reported to be 40 feet deep (see fig. 10). The shaft was flooded to within 25 feet

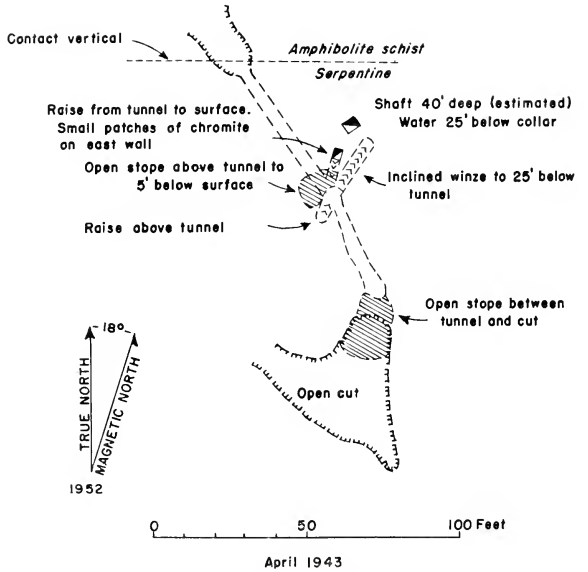

FIGURE 10. Geologic sketch map of the Park's Ranch chromite mine, Butte County

of the collar when the property was visited in April 1943, but all the other workings were accessible.

The deposit is near the northern contact of a narrow serpentine mass with amphibolite schist. The serpentine is only 200 to 300 feet wide and its contact with the schist is vertical. It is the dark-green "slickenite" variety of serpentine and is cut by many veinlets of calcite and slip-fiber asbestos. The size and shape of the workings indicate that the ore occurred as two large pod-shaped masses, and perhaps several masses of much smaller size, which pitched steeply north toward the contact of the serpentine and schist. Only a few small patches of ore remained on the walls of the workings when the mine was abandoned in 1942.

According to Louderback, the mine yielded 214 long tons of ore from 1916 to 1917 and 185 long tons in 1918. Other reports indicate that the 1916-18 production may have been only about 320 long tons. The mine yielded 121 long tons of ore in 1942. Assuming Louderback's figures are representative of the actual World War I production, the total production of the mine has been 520 long tons of ore. The ore shipped during World War I is reported to have contained about 42 percent Cr_2O_3, but that shipped in 1942 averaged only 37.98 percent Cr_2O_3 and contained 9.93 percent Fe, 6.89 percent SiO_2, and had a Cr to Fe ratio of 2.61. Although the deposit apparently has been worked out, exploration at a greater depth between the bottom of the winze and the serpentine-schist contact might reveal the presence of additional ore bodies. (Rynearson 43; Averill 43; Louderback 18; Thompson 18; Bradley 18; Waring 17)

Middle Fork of Feather River Area

Lone Star Claim (39)

L. A. Pope of Glendale located the Lone Star claim in 1942 on some small chromite deposits that had been opened by Dow Day of Berry Creek during World War I. The claim is located northwest of the Forest Service road in the $NE\frac{1}{4}$ sec. 10, T. 21 N., R. 6 E. The workings made during World War I consisted of an inclined shaft 12 feet deep at the northwestern end of the property and several shallow cuts between the shaft and the road.

According to Mr. Pope, the chromite occurred as several small lenses of ore along a shear zone in the peridotite. Several small lenses of ore, none of which appeared to contain more than about a ton of ore, were exposed in the workings in April 1943, and about 5 long tons of mined ore was scattered over the various dumps.

J. S. Means mined about 12 long tons of ore from the shaft in 1941. Part of this ore was shipped prior to 1943, but neither the shipper nor the disposition of the ore were known to Mr. Pope. The Oroville stockpile received 22.1 long tons of ore from V. F. Rodgers in June 1943. Rodgers reported the source of his ore as the "Day claim," and the location he gave coincides with that of the Lone Star claim. If Rodgers' ore came from the Lone Star claim, it is likely that he mined out all the ore described by Pope, and it is assumed that the deposit contains no reserves. (Rynearson 43)

Big Bend (40)

W. S. Day and F. H. Nix leased the Big Bend chromite deposit from the Central Pacific Railroad Co. during 1917-18. Day apparently discovered the deposit in the $SW\frac{1}{4}NW\frac{1}{4}$ sec. 11, T. 21 N., R. 6 E., early in 1917. A. E. Brune operated the property during 1918 under an assignment from Day and Nix. The Southern Pacific Land Co. owned the property in 1949. Thompson's report stated that the only workings made by July 1918 consisted of several open cuts. Brune mined several lenses of ore from the open cuts in 1918, and shipped a total of 90.4 long tons of ore containing about 48 percent Cr_2O_3. (Southern Pacific Land Co. 49; Louderback 18; Thompson 18; Bradley 18)

South Fork of Feather River Area

North Star (41)

B. J. Mullins discovered a chromite deposit in 1917 or 1918 in the $NE\frac{1}{4}SW\frac{1}{4}$ sec. 21, T. 20 N., R. 7 E. He located the North Star claim on the

deposit, but the claim proved to be invalid, as the property was owned by the Central Pacific Railroad Co. A. E. Brune leased the property and mined the chromite in 1918. The Southern Pacific Land Co. acquired the property later and sold it to G. A. Will in 1936. J. S. Means mined some ore in 1943 from a place he called the Red Mountain deposit, which apparently is the same as, or is near to, the old North Star deposit.

The ore occurred in the serpentine as irregular masses striking northwestward and dipping 70° E. Brune mined his ore from an open cut 40 feet long, from 5 to 10 feet wide, and about 5 feet deep. An outcrop of disseminated ore was found about 400 feet northeast of the open cut, but no work was done on this occurrence during 1918. In 1918 Brune shipped 85.3 long tons of ore containing 37 to 39 percent Cr_2O_3. In 1943 Means shipped from his Red Mountain deposit 49.7 long tons of ore containing 36.12 percent Cr_2O_3 and 11.35 percent Fe with Cr to Fe ratio of 2.18. As indicated above, it is assumed here that the ore mined by Means came from the old North Star mine. (Southern Pacific Land Co. 49; Louderback 18; Thompson 18)

Dickey and Dreisbach Prospect (45)

E. A. Dickey and F. M. Dreisbach opened a small chromite deposit in the SW¼ sec. 34, T. 20 N., R. 7 E., during World War I. In 1916 or 1917 they mined about 30 long tons of ore from a pit 10 feet long, 8 feet wide, and 10 feet deep. This ore was partly of the disseminated and partly of the nodular type, and contained about 35 percent Cr_2O_3. (Bradley 18; Waring 17)

Suzy Bell (Lucky Strike) Mine (46, 47) [25]

The Suzy Bell mine, formerly known as the Lucky Strike, is in the E½W½ sec. 4, T. 19 N., R. 7 E. The earlier Lucky Strike operation also included some prospects along the west edge of sec. 3. C. L. Falk discovered chromite on the property early in World War I and located the Brendt No. 1 "claim" on the principal deposits. The major chromite mining operations on the property were carried on during 1916-18 by E. A. Dickey and F. M. Dreisbach under a lease from the Butte County Pine & Hardwood Co. A. G. Arbueco, Warren Tinsley, and G. W. Tinsley renamed and reopened the deposits in 1942. Several open cuts were made in mining the chromite; the largest cut was about 50 feet long, 10 feet wide, and 12 feet deep.

According to Mr. Arbueco, ore was found at several places on the property. The largest deposit was on the Brendt No. 1 "claim" near the north end of the property. This deposit consisted of a lens of ore 8 feet wide at the center, about 50 feet long, and had a maximum depth of 12 feet. The ore body occurred in talcose (sheared?) serpentine, and had a strike of N. 45° W. and a dip of 80° SW. Dickey and Dreisbach took about 250 or 300 long tons of ore containing 36 to 40 percent Cr_2O_3 from this deposit and about 15 long tons of ore containing about 35 percent Cr_2O_3 from another deposit in sec. 3. (Source of these figures is explained under P. U. P. mine below.) In 1942 Arbueco and his associates mined 16 long tons of ore containing 35.09 percent Cr_2O_3 and 11.80 percent Fe with a Cr to Fe ratio of 2.03. No ore was exposed in any of the workings at the end of 1942. (Rynearson 43; Louderback 18; Bradley 18; Waring 17)

P. U. P. (Zenith) Mine (49) [26]

The P. U. P. mine, formerly called the Zenith, was reopened by G. W. and C. H. Peterson and G. W. Usher in 1942. The mine is located in the SE¼ sec. 6, T. 19 N., R. 7 E. The old Zenith mine also may have included the Strouse deposit (50) reported to be in the northeast corner of sec. 7. E. A. Dickey and F. M. Dreisbach operated the property during 1915-18 under a lease from the California Manganese Co. The principal mine opening made during the World War I operations was a large open cut about 100 feet long, which was along the course of an older tunnel. The operators during World War II made several small open cuts and some bulldozer cuts.

Waring's description of the deposit as it appeared in 1917 indicates that the ore occurred either as a large lens or as a series of smaller lenses striking about N. 30° E. in talcose serpentine. The shape and dimensions of the cut suggested that the ore body, or group of ore bodies, was about 75 feet long, 6 to 20 feet wide, and 12 feet deep. Apparently the virgin ore body was partly exposed by erosion, as much of the best ore found was picked up on the surface and grubbed from the soil near the surface.

Dickey and Dreisbach operated several deposits, and purchased ore from other deposits as well, under the name of the Zenith Chrome Mining Co., and the production figures submitted by the company were not broken down to show the various sources of the ores shipped. Records of the total production of the company differ widely, ranging from approximately 1,450 long tons to nearly 4,500 long tons. The production figures compiled by the U. S. Geological Survey show that the Zenith Chrome Mining Co. produced 37 long tons of ore in 1915, 1,129 tons in 1916, 246 tons in 1917, and 51 tons in 1918. These figures check closely with the production that would be expected from the deposits as described by Waring. Furthermore, on the basis of these descriptions, it is estimated that about 1,100 tons of ore came from the Zenith mine, 300 tons from the Lucky Strike mine, and 200 tons from other deposits in the area. These figures are believed to be representative of the actual World War I production from deposits in Butte County by Dickey and Dreisbach. The operators during World War II reported shipments of 37.3 long tons in 1942 and 7.9 tons in 1943. The ore shipped during World War I contained 35 to 37 percent Cr_2O_3 and that shipped during World War II contained 38 percent Cr_2O_3. In view of the relatively small production during World War II, no reserves can be estimated for the deposits. (Rynearson 43; Louderback 18; Bradley 18; Waring 16, 17; Diller 16; Dolbear 15; Thorne 14)

Plumas County

Introduction

Plumas County embraces an irregular area of 2,570 square miles at the northern end of the Sierra Nevada. It is bordered on the east by the Basin Ranges province and its northwestern tip extends into the southern part of the Cascade Range. Most of the county, however, lies within the Sierra Nevada province. At its northern end the Sierra Nevada has three crests, each of which represents the elevated edge of a separate tilted mountain block. The deeply dissected main block of the range occupies the southwestern part of the county, and the smaller

northwest-trending and southwestward-sloping Grizzly Mountain and Diamond Mountain blocks occupy the central and eastern parts of the county. Between the crests of these mountain blocks lie two northwest-trending series of intermountain valleys. Nearly all of the county is drained by the various tributaries of the Feather River. The main forks of this river have cut especially deep and rugged canyons in the main block of the range in the southwestern part of the county.

About two-thirds of the area of the county is timberland, and a large lumbering industry provides occupations for many of the 13,398 inhabitants (1950 census). Farming, mining, and water-power projects are other notable industries. The town of Quincy in the west-central part of the county is the county seat and is the commercial center for a large part of the county.

The general transportation system is relatively good for a mountainous region. The main line of the Western Pacific Railroad traverses the county from west to east through the canyon of the North Fork of the Feather River to Quincy, across a low divide to the Middle Fork of the Feather River, and thence eastward to Salt Lake City. A branch of this railroad extends northward from Keddie and connects with the Great Northern Railroad at Bieber in Lassen County. The principal paved highways are State Highway 24, which follows the general route of the railroad eastward through the central part of the county, and State Highway 36, which crosses the northern part. Other State, county, forest, and private roads provide ready access to most parts of the county, but some local areas, especially in the southwestern part, are virtually inaccessible.

Large areas of the eastern part of the county, which is underlain mainly by granitic rocks, are covered by Tertiary and Quaternary volcanic rocks and Quaternary gravels and alluvium. The southwestern part of the county, or that part including the main block of the Sierra Nevada, is geologically similar to adjoining parts of Sierra, Yuba, and Butte Counties. Of particular geologic interest is a belt of distinctive Paleozoic and Mesozoic rocks that trends northwestward across the central portion of the county, roughly coincident with the Grizzly Mountain block and the western margin of the Diamond Mountain block. This belt includes an unusually complete section of pre-Cretaceous sedimentary and volcanic rock units, many of which are not found or at least have not been identified in other parts of the Sierra Nevada. The lithology and structure of these rocks were described in considerable detail by Diller (08) in his report on the Taylorsville region.

Ultramafic rocks occur in three belts in the western half of the county. The eastern belt trends northwestward from Grizzly Peak through the Greenville area almost to the town of Almanor and includes several irregular to elongate masses of serpentine, pyroxenite, and gabbro. The western belt trends northward for about 12 miles from the southernmost tip of the county and then curves sharply westward into Butte County. Little is known about the character and structural relationships of the numerous large and small ultramafic masses in this belt, and some of the masses outlined on plates 12 and 13 may include talc, chlorite, and amphibole schists derived from other than ultramafic rocks. The central belt, which is a continuation of the "great serpentine belt," is by far the most important of the three belts. It consists of an impressive

body of ultramafic rocks from 1½ to 4½ miles wide that trends northwestward from the northern tip of Sierra County across most of Plumas County and underneath the volcanic rocks of the Cascade Range.

No chromite deposits in the ultramafic masses of the western belt have been reported and only three in just one mass of the eastern belt have been reported. All the other known deposits occur in the mass forming the central belt, and most of these are located in a relatively small area bordering the Middle Fork of the Feather River.

History and Production

Turner (98) noted the occurrence of deposits of chromite in the Meadow Valley area of Plumas County in the early nineties, but so far as is known no chromite was mined in the county until 1916. Since 1916 nearly 50 deposits have been mined or prospected, yet only about 1,500 long tons of chromite has been produced. Less than 400 long tons of ore was shipped from the 10 or 12 deposits that were opened during World War I. A more active interest was taken in the deposits during World War II, however, and a total of a little more than 1,000 long tons of ore was shipped from 24 deposits during 1941-44. The convenient location of a purchasing depot and stockpile at Quincy doubtless stimulated production.

More than half of the chromite ore produced from Plumas County came from two deposits; one deposit in the Rock Creek area yielded about 550 long tons of ore and one deposit in the Greenville area yielded about 240 tons. These and one other deposit are the only ones in the county that have yielded more than 100 long tons of ore. The ores from perhaps no more than 10 deposits had Cr to Fe ratios higher than 2.5, and the Cr_2O_3 content of at least two of these ores was less than 45 percent.

The reserve of ore remaining in the known deposit is almost inconsequential, and any new deposits that may be found are likely to be quite small. Nevertheless, further prospecting in the central belt of ultramafic rocks might well result in the discovery of additional deposits that could be worked by the small operator under favorable market conditions.

Detailed production figures for deposits in the county are given in table 12.

Mines and Prospects

Greenville Area

Wolf Creek Claim (1)

The Wolf Creek claim is located in the S½SE¼ sec. 36, T. 27 N., R. 8 E. It is one of three claims making up the patented gold property known as the Gold Stripes mine now owned by Mrs. Cassie M. Hamilton of Oroville. George Hall and Levi Bacher apparently owned the property during World War I, as they leased the rights to mine chromite on the Wolf Creek claim first to C. W. Adams in 1916 and the early part of 1917 and then to Samuel Altshuler of San Francisco later in 1917 and during 1918. The only workings made while mining for chromite were shallow pits and small open cuts.

Very little is known about the nature or location of the work done by Adams except that he did mine some ore on the property. Altshuler mined about half a dozen small pods of ore from the northwestern part of the claim. This ore all came from one small area and each pod yielded about

Table 12. Chromite production from Plumas County, California (in long tons)

Property	Map no.	1916	1917	1918	1919-40		1941	1942	1943	1944-49		Total	Total unofficial estimate*
					Year	Tons				Year	Tons		
Big Four					1919	[b](38)							
Boss Quail				[2]								[1]	?
Cattle Springs	24								47			47	47
Cedar Flat	14				1939	20	[3]		1			21	35±
Chicago	46								16			16	16
Clover Leaf	28									1944	25	25	25
Commander	38								23			23	23
Cough group	15-17						[1]		7			7	18
Diamond	30									1944	22	22	22
Edeline								6				6	6
Fido	29			[2]					[b](20)			[1]	?
Gifford				5								5	5
Horseshoe No. 2	41								[b](10)				
Hudson	11							11				11	11
Jack Forth	8								12	1944	30	42	42
Last Chance	44, 45							7				7	7
Mammoth	42								[4]			[4]	?
McCarty	27		[1]	120					[b](50)			120	50±
Pine Flat group	19-21								[3]			[3]	50±
Poodle Dog	2			[1]					22			22	22
Red Hill	5							28	8			36	36
Ridley								6				6	6
Section 36	12								9			9	9
Shennandoah	7								3			3	3
Skyline No. 1	6								12			12	12
Skyline No. 2	6								38			38	38
Spot	23						[3]	[3]	[3]			[3]	60±

Tip Top					1919	[b](32)							
White Fir	34								35			35	35
White Pine	22						134	259	279			672	550±
Wolf Creek	1	[a]40	[a]160	[1]	1919	[b](45)						200	240
Unknown (Onion Valley)		[a]54										54	54
Unknown (Meadow Valley)							64					64	64
Totals		94	160	125		20	198	317	512		77	1,503	1,486±
Federal totals		125		125									
State totals		53	423										

* Totaled separately. Estimates based on information obtained from all available sources.
[a] Amount reported to California Division of Mines.
[b] Ore reported stocked at end of previous year, not added because some may be below shipping grade or because some may have been shipped under another name in a subsequent year.
[1] Some production reported, but amount not specified.
[2] Included in production of McCarty mine.
[3] Included in production of White Pine mine.
[4] Included in production of White Fir claim.

20 to 40 long tons. A part of Altshuler's production came from large boulders of float dug from the soil on a flat below a steep serpentine outcrop from which several small ore bodies evidently had been eroded. Some of the float boulders weighed as much as 8 or 10 long tons each.

Accurate production figures for the chromite deposits on the property are not available. Adams reported his production as 125 long tons in 1916 and about 200 tons in 1917, but some of this ore may have come from other Plumas County operations and some even may have represented manganese ore. George Hall reported the chromite production of the Gold Stripes mine as 40 long tons for 1916 and 53 tons for 1917, and these figures probably are closer to Adams' actual production, though Altshuler told the writer he believed Adams did not produce more than one carload of ore from the property. Altshuler mined and shipped 107 long tons of Wolf Creek ore in 1917 and about 40 tons in 1918. This ore contained only 30 to 34 percent Cr_2O_3. Averill reported that the dumps of some caved pits in sec. 36 held some 30 long tons of ore in 1937. This ore was mined during World War I and may have come from the deposit or deposits worked by Adams and Altshuler. (Rynearson 49; O'Brien 43; Averill 37; Bradley 18)

Poodle Dog Claim (2)

According to Samuel Altshuler, the Poodle Dog claim adjoins the Wolf Creek claim on the southeast and lies mostly in the northeast corner of sec. 1, T. 26 N., R. 8 E. It was owned by B. K. Melville of Oakland in 1918 and evidently is part of the property Averill (37) described as belonging to the Peerless Development Co., of which Melville is president. This company also owns several adjoining claims, including the Gold Stripe claim, which originally was part of the Gold Stripes mine. In previous reports the Poodle Dog claim has not been referred to by that name, but has been included with the Wolf Creek under the name of Gold Stripe or Gold Stripes property.

Altshuler leased the chromite mining rights on the Poodle Dog claim from Melville in 1918 and mined, but did not ship, about 18 or 20 long tons of rather low grade ore. This ore probably formed a part of the 40 long tons of ore Averill reported as lying on the dumps of several shallow pits in 1937. J. R. North and August Eddelbuttel shipped 21.5 long tons of ore from the property in 1943. This ore contained 37.44 percent Cr_2O_3 and 11.90 percent Fe with a Cr to Fe ratio of 2.15. It may be that the ore shipped in 1943 was obtained by sorting the better grade of material from the 40 tons of mined ore that Averill reported (Rynearson 49; O'Brien 43; Averill 37)

Spillover Placer and Quartz Claims (3)

Albert Ziebar of Greenville had collected about half a ton of float chromite in 1942 from parts of the Spillover Placer and Quartz claims in the NW¼(?) sec. 6, T. 26 N., R. 9 E. He was searching for the source of the float, but apparently did not locate any notable ore bodies in place, as no shipments of ore have been made from the property. (O'Brien 43)

Valley View

Several previous reports have credited the Greenville area with a so-called chromite deposit named the Valley View that was owned by W. B. Boyden and Fred Koenig in 1917-18. These references apparently all originated from information obtained from a local railroad agent and

from the County Recorder's Office by Waring in 1917. According to this information, the Valley View property yielded one carload of ore in 1916 and two carloads in 1917. This ore was said to contain about 32 percent Cr_2O_3. However, Samuel Altshuler has informed the writer that he leased the Valley View property from Boyden and Koenig in 1918 and that the deposits contained manganese rather than chromite ores. Altshuler recalled that the property was in sec. 21(?), T. 26 N., R. 9 E., and said he knew of no serpentine masses in the immediate vicinity. In view of the first-hand evidence given by Altshuler, the writer believes the information given to Waring was erroneous and that the Valley View property has been referred to wrongly as a chromite deposit. (Rynearson 49; Averill 37; MacBoyle 20; Bradley 18; Waring 17)

North Fork of Feather River Area

Blue Jay Prospects (4)

C. L. Gander and Tom Ormand of Belden mined a little chromite in 1943 from shallow pits and trenches on a property called the Blue Jay Chrome mine in secs. 31 and 32, T. 26 N., R. 7 E., between Yellow Creek and the North Fork of the Feather River. No ore has been shipped from the prospects. (O'Brien 43)

Red Hill and Skyline Claims (5, 6)

George Maxwell of Virgilia owned and operated two or three chromite claims in 1942-43 that he called the Skyline No. 1 and No. 2 and the Red Hill(?) claims, all located on Red Hill in sec. 10, T. 25 N., R. 7 E. In 1943 Maxwell shipped 7.5 long tons of ore from the Red Hill(?) claim, 12.3 long tons of ore containing 42.74 percent Cr_2O_3 and 13.56 percent Fe with a Cr to Fe ratio of 2.16 from the Skyline No. 1 claim, and 37.6 long tons of ore containing 46.03 percent Cr_2O_3 and 13.02 percent Fe with a Cr to Fe ratio of 2.42 from the Skyline No. 2 claim.

A shipment of 28.2 long tons of ore containing 40.46 percent Cr_2O_3 and 12.21 percent Fe with a Cr to Fe ratio of 2.27 was delivered to the Quincy stockpile in 1942 by Maxwell and Harry Fuller. The source of this ore was designated only as a deposit in the Virgilia district owned by a Mr. Hunt of Quincy. It is possible that this deposit was the same as or at least near to one of the group described in the foregoing paragraph. (Rynearson 42, 43)

Meadow Valley Area

Shennandoah Claims (7)

A. A. Benner and R. E. Barrington of Quincy leased the Shennandoah No. 1 and No. 2 claims in the NW¼ sec. 25, T. 25 N., R. 7 E., from August Eddelbuttel in 1943. According to Barrington, about 12 long tons of ore had been mined from open cuts on the claims by early 1943, and an 18-inch width of ore still showed in one cut. Slightly less than 3 long tons of the ore mined was shipped to the Quincy stockpile and included with a mixed lot. The grade of the ore is not known, but it probably contains considerably less than 40 percent Cr_2O_3, perhaps even less than 35 percent, as the remainder of the ore mined was not shipped. (Rynearson 43)

Jack Forth Claims (8)

Jack Forth located several chromite claims in secs. 18, 22, and 34, T. 25 N., R. 8 E. S. R. Weeks shipped 12.4 long tons of ore in 1943 and

29.6 tons in 1944 from these claims. Most, if not all, of this ore came from one deposit in the $SE\frac{1}{4}$ sec. 18. The ore averaged 36.28 percent Cr_2O_3 and 12.24 percent Fe with a Cr to Fe ratio of 2.03.

Fuller Claims (9-11)

Harry Fuller located six chromite claims in T. 24 N., R. 8 E., in the Meadow Valley area—the Hillside (9) in the $NW\frac{1}{4}$ sec. 9, the Florence (10) in the northeast corner of sec. 16, the Hudson (11) in the $N\frac{1}{2}$ sec. 27, and the Snow White Nos. 1-3 whose locations are not known. The Hudson claim was held jointly with E. R. Smith. Three of these claims may be relocations of the Tip Top claim owned by J. L. Foisie and the two claims owned by J. Gifford and leased to F. R. Young and A. L. Smith during World War I. The Florence and Hudson claims may represent the two chromite deposits Turner (98) marked on his folio map.

No information is available as to the nature or extent of any of these deposits. Fuller shipped 11.1 long tons of ore containing 45.16 percent Cr_2O_3 and 12.17 percent Fe with a Cr to Fe ratio of 2.54 from these claims in 1942. Some, if not all, of this ore came from the Hudson claim. (Logan 43)

Section 36 (12)

George Maxwell shipped 9.4 long tons of ore in 1943 from a small deposit on the property of a timber company in the northeast corner(?) of sec. 36, T. 24 N., R. 8 E. This ore was included with a mixed lot; therefore the grade is not known.

Miscellaneous Deposits

The Quiney stockpile received small shipments of ore from two other deposits in the Meadow Valley area during 1942. Ray Edeline delivered 6.1 long tons of ore containing 46.85 percent Cr_2O_3 and 13.60 percent Fe with a Cr to Fe ratio of 2.35. R. G. Ridley delivered 9 long tons of ore containing about 37 percent Cr_2O_3, which was mixed with a few tons of ore from the White Pine deposit. Ridley's ore consisted entirely of float.

Rock Creek Area

Cedar Flat Claim (14)

The Cedar Flat claim is situated along the west edge of the Rock Creek road in the $SW\frac{1}{4}$ sec. 6, T. 23 N., R. 9 E. Louis Eddelbuttel located the claim and sold it to E. R. Patterson and E. V. Spivey of Quiney. When visited by the writer in October 1942 the workings consisted of an open cut 60 feet long, 5 feet wide, and 8 feet deep, and a shallow trench. No ore was visible in the workings, but about 5 long tons of low-grade ore was on the dump. The amount of ore taken from the deposit is not known, but it probably did not exceed 50 long tons. All or part of the 20 long tons of ore shipped by Eddelbuttel in 1939 may have come from this deposit, and a small part of the 134 long tons shipped by Patterson and Spivey in 1941 has been credited to the claim. In 1943 A. A. Benner and R. E. Barrington sorted about one ton of ore from the 5 tons on the dump and included it with a mixed lot delivered to the Quiney stockpile. (Logan 43; Rynearson 42)

Cough Group (15-17)

A group of three claims called the Cough Nos. 1-3 were held by location by F. G. Myers of Stockton in 1943. These claims were laid out end

to end along a line trending a little east of north through the central part of sec. 8, T. 23 N., R. 9 E. They were known previously as the Salt Extension, Spice, and Pepper claims. Apparently the only ore found in place was on the No. 3 (Pepper) claim as Allen (41) reported that about 2 tons of ore had been mined from several shallow trenches there. Float ore was scattered over all three claims, however, and George Maxwell gathered up and shipped about 18 long tons of the float under a lease from Myers during 1941-43. E. R. Patterson and E. V. Spivey held a lease on the claims during 1943-44, but apparently did little work on them as no other shipments of ore have been credited to this group of claims. (Rynearson 43; Gros 42; Allen 41)

Pine Flat Group (19-21)

E. R. Patterson and E. V. Spivey located the Pine Flat Nos. 1-3 claims along a line extending a little east of north from the White Pine claim (22) and near the line between secs. 8 and 9, T. 23 N., R. 9 E. These claims evidently cover the same ground as the Bald Mountain No. 1 and No. 2 claims located by Vernon Baruth in 1937.

About 15 long tons of ore was mined from an open cut on one ore body near the center of the No. 1 claim, and only a few small stringers of chromite remained in the cut. Approximately 35 long tons of float ore was picked up near the common end line of the No. 1 and No. 2 claims. This ore was piled on the claims in June 1943, but was shipped to the Quincy stockpile later in the same year. (Rynearson 43; Gros 42; Allen 41)

White Pine Mine (22) [19]

The White Pine deposit is the largest of a group of several chromite deposits exploited by E. R. Patterson and E. V. Spivey of Quincy during World War II. It is situated in the $NE\frac{1}{4}NE\frac{1}{4}$ sec. 17, T. 23 N., R. 9 E., at an altitude of about 5,250 feet. Louis Eddelbuttel located the Bear claim on the deposit in 1937. Patterson and Spivey bought out Eddelbuttel's interests, renamed the claim the White Pine, and carried on seasonal mining operations during 1940-43. When the deposit was first visited by the writer in October 1942 the workings consisted of a large, irregular open cut 500 feet long, 30 to 100 feet wide, and 10 to 50 feet deep. By June 1943 the cut had been enlarged somewhat, and it is probable that the operators deepened some parts of the cut and extended it to the southeast during the later part of that year. A shallow shaft sunk on the original ore discovery was obliterated soon thereafter by the open cut and no other underground openings were made. The pre-mining surface of the area was deeply weathered and was covered with a mantle of red clay and soil of variable thickness, thus making it possible to do most of the excavation work with a bulldozer and carryall.

At the time of Allen's visit (1937 or 1938) several shallow cuts 10 to 15 feet long had been dug in the overburden. One of these had exposed angular blocks of chromite in the red soil. Large-scale mining operations were begun in 1940 after the shaft had uncovered a small stringer of ore in place. At depth this stringer developed into a pod of massive ore (the third ore body described below), and subsequent mining operations led to the discovery of three more pods of ore.

The deposit consisted of a series of pods of chromite occurring along a shear zone in and roughly parallel to the elongation of a long, narrow

mass of dunite enclosed by saxonite. The shear zone strikes N. 30°-35° W. and dips 40°-45° NE. The sheared rocks are weathered deeper than the rocks on either side. The exposures in the cut were too poor and the rocks were too weathered to permit the delineation of the shape of the dunite mass in detail, but the mass appeared to be widest at the southeast end of the cut, at which point it may be more than 100 feet wide. The rocks underlying the mantle of red clay and soil are all more or less serpentinized, but those that are not highly sheared still retain many of their original characteristics and in most places the dunite can be readily distinguished from the saxonite. Some of the dunite contains a fibrous amphibole, and both dunite and saxonite contain a little talc. These minerals are secondary alteration products, probably associated with the processes of serpentinization and regional metamorphism.

The largest of the four ore bodies found was discovered when its upper edge was uncovered by a bulldozer cut near the southeast end of the deposit. By June 1943 this ore body had been mined to a depth of 30 to 35 feet and the exposed section had a horizontal length of about 15 feet and a width of 3 to 8 feet. The strike and dip of the ore body were roughly parallel to the corresponding elements of the shear zone, but the long axis of the body pitched S. 70° E. at an angle of about 30°. This pod contained approximately 200 long tons of ore.

A second ore body was located about 45 feet northwest of the one described above. It had a horizontal length of about 20 feet and a maximum thickness of 6 feet, narrowing to a thin stringer at the northwest end. It had been mined from a point just below the soil cover to a depth of 25 to 30 feet and was thicker near the bottom than near the top. The body eventually yielded between 150 and 175 long tons of ore.

A third ore body—the original discovery—was located about 80 feet northwest of the second one described. Mining was begun on this ore body with a shaft to a depth of 7 feet, but the shaft was abandoned in favor of the open cut method of mining. The ore body was mined to a depth of 25 feet, where it narrowed to a stringer only 4 to 6 inches wide. The maximum thickness of the ore was about 4 feet and the average horizontal length about 5 feet, not including the narrow stringers that projected from the main mass along the strike. This pod yielded about 150 long tons of ore.

The fourth and smallest ore body was found about 35 feet northwest of the third. It did not extend quite to the hard-rock surface and pinched out at a depth of 15 feet, yielding only about 25 long tons of ore.

Because the amount of ore shipped after June 1943 closely approximates the amount of ore in sight at that time, it is not likely that any additional ore bodies were found. Also, it is doubtful that the operators followed the marginal chromite stringers more than a few feet into the floor and ends of the cut, as the dimensions of the cut had reached a stage where sloughing and caving would become a serious problem, especially during wet weather, and costly underground mining methods would have to be resorted to in order to exploit the deposit much further.

One of the notable features of the deposit is that thin stringers of chromite connected all four of the known ore bodies, indicating a unity of the deposit as a whole. Another notable feature is the relative uniformity of orientation of the four ore bodies. The long axis of each pitched to the southeast, and the axial centers fell close to a straight

line having a gentle pitch to the northwest roughly parallel to the ground surface. The geometry of the deposit therefore suggests that additional ore bodies would most likely occur in the shear zone near the northwest or southeast extensions of the line of centers. However, the possibility of other ore bodies occurring at depth in the direction of the pitch of the known bodies should not be overlooked. Exploration of the possibilities suggested above might well include a small-scale drilling program using either a diamond drill or a wagon drill equipped with sectional steel, providing the operator could finance such a program.

Patterson and Spivey shipped 107 long tons of ore containing about 50 percent Cr_2O_3 and 27 long tons containing about 47 percent Cr_2O_3 to private purchasers during 1941. In 1942 they shipped 34.2 long tons to the Metals Reserve Co. stockpile at Salt Lake City and 225.1 long tons to the stockpile at Quincy. In 1943 they shipped 278.7 long tons (including a small lot delivered by Frank Maurezzio) to the stockpile at Quincy. Most of the ore shipped in 1941 came from the White Pine deposit, but about 25 tons may have come from the Cedar Flat and Spot claims. An indication of the approximate amounts of ore shipped from the several deposits operated by Patterson and Spivey during 1942 and 1943 is given by the assay data. On the basis of similar assays, the shipments can be segregated into two distinct groups. Of the ore shipped during these two years, 448.6 long tons averaged 50.56 percent Cr_2O_3 and 10.61 percent Fe with a Cr to Fe ratio of 3.45. The greater part of this ore undoubtedly came from the White Pine deposit. The remainder of the ore shipped, 89.4 long tons, averaged 39.79 percent Cr_2O_3 and 11.07 percent Fe with a Cr to Fe ratio of 2.46, and probably represents ore produced mostly from the Spot, Pine Flat, and Cedar Flat claims. The total amount of ore yielded by the White Pine deposit is therefore approximately 550 long tons. (Rynearson 42, 43; O'Brien 43; Logan 43; Gros 42; Allen 41)

Spot Claim (23)

The Spot claim, previously known as the Salt claim, is located in the $NW\frac{1}{4}NE\frac{1}{4}$ sec. 17, T. 23 N., R. 9 E., about 100 yards east of the junction of the Rock Creek and Forest Service roads and several hundred yards west of the White Pine claim. The claim was owned and operated by Patterson and Spivey in 1941-43. In 1943 the chromite deposits on the claim had been opened by a bulldozer cut about 300 feet long and by several small prospect pits.

The ore occurs as a series of elongate lenses along a line striking N. 30° W. The largest of these ore bodies, one found just above the road, had a strike of N. 40° W. and a dip of 80° NE. It was about 25 feet long with an average thickness of about 2 feet and originally contained about 50 or 60 long tons of ore. The other lenses were relatively small. A little ore a few inches wide was exposed by the road cut and a boulder of chromite 2 feet in diameter was rolled out when the road was built. Small stringers of ore had been prospected about 300 feet northwest of the large cut, and these may represent a continuation of the main ore zone.

About 40 long tons of ore was shipped from the deposit during 1941-42 and the first half of 1943, and 20 to 30 long tons of ore probably was shipped later in 1943. As most of the ore shipped was included with

ore from the White Pine or other deposits, no accurate figures on the tenor of the ore are available. It is estimated, however, that the ore contained about 42 percent Cr_2O_3. (Rynearson 42, 43; Logan 43; Gros 42; Allen 41)

Cattle Springs Claims (24)

The Cattle Springs No. 1 and No. 2 claims were located first by August Eddelbuttel in 1940 and then relocated by Patterson and Spivey in 1942. The property is situated in the SW¼NE¼ sec. 9, T. 23 N., R. 9 E. James Melone of Quincy leased the property in 1943 and operated it under the name of the Sundown Mining Co.

Very little development work had been done at the time the writer visited the property in June 1943. Float had been found scattered over a wide area in the creek bottom on the No. 1 claim and a little float had been found on the No. 2 claim. Melone claimed he had traced the source of the float on the No. 1 claim to a marshy spring area in the creek bed and had outlined an area 18 feet wide and 22 feet long from which he had obtained concentrations of chromite sand in the cuttings of a series of auger holes. Melone evidently uncovered an ore body at this or some other place because a short time after the writer's visit the Sundown Mining Co. began delivering ore from these claims to the Quincy stockpile. During the latter part of 1943 the company made several shipments aggregating 71.5 long tons of ore averaging 38.87 percent Cr_2O_3 and 11.68 percent Fe, with an average Cr to Fe ratio of 2.28. There is some question, however, as to the source of all this ore; about one-third may have come from the White Fir claim (34) of the Benner and Barrington group. (Rynearson 43)

Middle Fork of Feather River Area

McCarty Mine (27)

The McCarty (or Jitney) mine is located near the center(?) of sec. 14, T. 23 N., R. 9 E., about 10 feet above the normal high-water level on the northeast bank of the Middle Fork of the Feather River. Thomas McCarty of Quincy located the Jitney No. 1 and No. 2 claims during World War I and apparently maintained his title to the claims until 1942, at which time Frank Maurezzio, also of Quincy, was reported to have located the ground as the McCarty Nos. 1-6 claims. George Maxwell of Virgilia claimed ownership of the McCarty No. 1 and No. 2 claims in 1943. The Union Chrome Co. leased the property from McCarty in 1917-18 and opened an ore body on the McCarty No. 1 (Jitney No. 1) claim. The old workings are reached by a steep trail winding down from a Forest Service road that ends on the rim of the canyon about 3,000 feet higher than the river. Some ore was packed out over this trail in 1917 or 1918, but the difficulties and high cost of getting the ore to the road have discouraged other interested parties from mining and shipping the ore that remains in the deposit.

The following description of the deposit summarizes the information contained in numerous earlier reports, published and unpublished, that have been made on the property.

The deposit evidently consists of one lenticular ore body that strikes about north and dips 80° W. The length of this body is about 80 feet and its maximum width is 12 feet, but the depth to which the ore extends is not known, as ore remains in the bottom of an open cut 6 to 10 feet deep. The southern quarter of the body is offset about 5 feet eastward from the

northern part by a transverse fault. The upper part of the body was separated from the lower part by a thin wedge of serpentine. Although a little differential movement has occurred along the margins of the body, the contact is sharp and the ore does not break cleanly from the wall rock. The ore is coarse-grained and contains 40 to 48 percent Cr_2O_3. One previous report erroneously stated that the ore occurred in limestone. An inclusion or inlier of sugary gray marble occurs in the peridotite about 50 feet east of the deposit, but the rock surrounding the ore body is hypersthene saxonite, which is but little altered to serpentine.

Most previous reports indicate that about 200 long tons of ore was mined from the open cut during 1917-18 but that only about 50 tons of this was shipped. Mr. E. R. Patterson informed the writer that only 50 tons of ore was piled at the cut in June 1943, so approximately 100 tons of the ore mined during World War I is unaccounted for. It is possible, however, that some unreported shipments may have been made between 1918 and 1943. It also is possible that some ore was washed away by river floods. Gros (42) estimated the area of ore exposed in the cut to be about 200 square feet. If this amount of ore extends to a depth of 5 feet or more, the reserve of unmined ore may amount to more than 100 long tons. As far as is known, the 50 tons of mined ore reported by Patterson has not been shipped. (Logan 43; Gros 42; Averill 37; Bradley 18; MacBoyle 20; Thompson 18; Taliaferro 17, in Louderback 18; Waring 17)

Clover Leaf Claim (28)

A chromite deposit on the Clover Leaf claim in the NE¼ sec. 23, T. 23 N., R. 9 E., yielded 25.3 long tons of ore containing 43.04 percent Cr_2O_3 and 11.53 percent Fe with a Cr to Fe ratio of 2.55. This ore was delivered to the Quincy stockpile by George Maxwell in 1944. No other information is available regarding the property.

Fido Claim (29)

August Eddelbuttel at one time owned a claim he called the Fido claim in the NE¼SE¼ sec. 16, T. 23 N., R. 9 E. This claim may represent a property of the same name that was one of three deposits in the area operated by the Union Chrome Co. during World War I. About 15 to 20 long tons of ore was said to be piled on the claim in 1943, and still may be there, as no shipments from this deposit have been reported since 1918. (Rynearson 43; Allen 41)

Benner and Barrington Group (30-34)

A. A. Benner and R. E. Barrington of Quincy held five chromite claims in the S½ sec. 16, T. 23 N., R. 9 E., in 1942-43. The White Fir, Oakie, Lucky Three, and Diamond claims were held by location and the Pine Cone claim was leased from August Eddelbuttel. The claims are reached by about 2 miles of mine road from the end of the Rock Creek road.

A small lens of chromite on the White Fir claim (34) was being mined from an open cut 15 feet long, 4 feet wide, and 15 feet high at the face in June 1943. The ore body was about 2 feet thick and 10 feet long.

Two bulldozer cuts constituted the only workings on the Oakie claim (32). A few fragments of ore on the dump of one cut indicated that some ore had been mined, probably from a small stringer or lens. A very thin stringer of chromite (one-fourth inch thick) was exposed in the dunite in the cut.

The only work done on the Lucky Three claim (31) consisted of two shallow trenches from which only a few pounds of ore had been extracted, and no ore was exposed.

About 2 long tons of ore was reported piled on the Pine Cone claim (33), which was not visited by the writer.

The workings on the Diamond claim (30) could not be located when the writer visited the area. It was reported that about 15 long tons of ore had been mined from one ore body, which had a maximum thickness of 4 feet. The mine road did not extend all the way to this deposit in 1943, but E. R. Patterson and August Eddelbuttel must have completed the road, as they shipped some ore from the claim in 1944.

Benner and Barrington are credited with the production of 22.6 long tons of ore in 1943. Shennandoah and Cedar Flat claims contributed 3.2 long tons of this ore, and the remainder, 19.4 long tons containing 38.81 percent Cr_2O_3 and 12.02 percent Fe, with a Cr to Fe ratio of 2.21, probably came from the White Fir claim, although some may have come from Benner and Barrington's Mammoth claim (42) south of the Middle Fork of Feather River in sec. 28, T. 23 N., R. 9 E. Patterson and Eddelbuttel shipped 22.3 long tons of ore containing 45.53 percent Cr_2O_3 and 11.37 percent Fe, with a Cr to Fe ratio of 2.74, in 1944, and reported its source as the Diamond claim. (Rynearson 43)

Maurezzio Group (35-39)

A group of five chromite claims—the Deerhorn (37), Deerhorn Extension (36), Commander (38), Commander Extension (35), and Bottle Springs (39) claims—located in the SE¼ sec. 17, T. 23 N., R. 9 E., was owned and operated in 1942-43 by Frank Maurezzio and R. R. Jesky of Quincy. In June 1943 the only workings on the property consisted of one long open cut, a drift 30 feet long, and a small prospect pit on the Commander claim and a bulldozer prospect trench on the Bottle Springs claim. Float had been found on the other claims, but the sources had not yet been found.

The open cut and drift were about 125 feet apart on a shear zone containing a series of small lenses and stringers of chromite. One lens mined from the open cut yielded 14 long tons of ore containing 38.86 percent Cr_2O_3, 11.65 percent Fe, 9.80 percent SiO_2, 15.43 percent MgO, and 16.41 percent Al_2O_3, and had a Cr to Fe ratio of 2.31. The drift had been driven close to the ground surface along the shear zone toward the open cut. It had not penetrated the weathered zone, but a narrow seam of chromite could be traced for about 10 feet along the back.

The prospect pit had partly exposed a small lens of ore for about 6 feet along the strike of another shear zone. Considerable float had been found on the slope below and a little east of the pit. It seemed entirely possible that this float had a source in the second shear zone.

The bulldozer trench on the Bottle Springs claim was started to trace float, but no ore had been found in place. No ore had been found in place on the other three claims either.

Maurezzio delivered 23.3 long tons of ore averaging 38.76 percent Cr_2O_3 and 12.11 percent Fe with a Cr to Fe ratio of 2.19 to the Quincy stockpile, all of which came from the deposits on the Commander claim. He also delivered 11.7 long tons of ore that was credited to the White Pine claim. (Rynearson 43; Logan 43)

Horseshoe Claims (40, 41)

E. R. Patterson and E. V. Spivey obtained the Green Ledge claim from August Eddelbuttel and renamed it the Horseshoe No. 2 claim (41). The Horseshoe No. 1 claim (40) probably is a relocation of the King Snake claim referred to by Allen. These claims are in the $NW\frac{1}{4}$ sec. 21, T. 23 N., R. 9 E. Patterson informed the writer that about 10 long tons of ore had been mined on the No. 2 claim and still was piled there in June 1943. The deposit is about 2 miles by steep trail from the nearest road, and there is no record of the ore having been packed out. (Rynearson 43; Logan 43; Allen 41)

Last Chance Group (42-45)

August Eddelbuttel and C. W. Goodrich located the Last Chance No. 1 (44) and No. 2 (45) claims and the Meadows claim (43) in the $NW\frac{1}{4}$ sec. 33, T. 23 N., R. 9 E. A. A. Benner and R. E. Barrington leased these claims in 1943, and located the Mammoth claim (42) somewhere in the $S\frac{1}{2}$(?) sec. 28, T. 23 N., R. 9 E. Eddelbuttel shipped about 7 long tons of ore from the Last Chance claims in 1942 and had stockpiled about 30 long tons of ore on the Last Chance No. 2 claim. Benner and Barrington may have shipped as much as 11 long tons of ore from the Mammonth claim, but made no shipments from the other claims. Consequently, these claims should hold some promise for future prospectors. (Rynearson 43)

Chicago Claims (46)

Louis and August Eddelbuttel and J. R. North shipped 15.9 long tons of ore containing 41.52 percent Cr_2O_3 and 11.19 percent Fe with a Cr to Fe ratio of 2.54 from the Chicago No. 1 and No. 2 claims in 1943. These claims were reported to be in sec. 36, T. 23 N., R. 9 E., probably in the southeast quarter. No other information concerning these claims is available.

ALPHABETICAL LISTS OF CHROMITE MINES AND PROSPECTS

All the known chromite mines and prospects in the northern Sierra Nevada are listed alphabetically by counties in tables 13-18. These tables include all the reported names by which the properties have been known, but an attempt has been made to correlate and cross-reference names that have been used to designate identical properties. Preference is given, however, to the newest name known unless an older name has local preference because of long-continued common usage. Ownership is given as of the date of the latest report available and, therefore, few of the current owners may be indicated. The map numbers preceding property names correspond to those shown on plates 2 and 3 as well as to those used in the text. The production of a deposit, if known, is indicated by a letter symbolizing one of four classes of production: A, deposits from which at least 1,000 long tons of ore has been shipped; B, deposits from which 150 to 1,000 long tons of ore has been shipped; C, deposits from which small amounts of ore, but not more than 150 long tons, has been shipped; and D, deposits from which no ore has been shipped. The letter X is used, in table 15 only, to denote questionable production for some deposits from which some ore may have been shipped under a name other than that listed.

Table 13. Alphabetical list of chromite mines and prospects in Butte County, California

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Agard and Stewart: *see* Stewart, Section 35						
2	Anti-Axis	F. H. Snow and Roy McClendon: 1943	$SW\frac{1}{4}SE\frac{1}{4}$ 27	24	3	C	Small pods of ore along shear zone.
	April Fool	Edwin Barnham and Harry Edwards: 1918	?	22	5	C	May be same as Section 13.
42	Bear Canyon	George Wooley	?	20	7	C	
	Big Bar: *see* Stewart						
40	Big Bend	Southern Pacific Land Co.: 1949	$SW\frac{1}{4}NW\frac{1}{4}$ 11	21	6	C	Probably worked out.
18	Big Pine	J. H. Brassell: 1943	$NW\frac{1}{4}SE\frac{1}{4}$ 34	23	5	D	Concentrating ore.
	Big Wonder	Harry Edwards: 1918	25	22	5	D	Low-grade ore.
	Brendt No. 1: *see* Suzy Bell						
	Brune and Stanley: *see* Stewart						
4	Christian Place	R. E. Miller: 1943	$NE\frac{1}{4}NE\frac{1}{4}$ 32	23	4	C	
	Clark: *see* War Eagle						
	Clipper Queen: *see* Diamond Queen						
	Cox	Wm. Cox: 1918	?			D	
	Curtis: *see* Park's Ranch						
	Day claim: *see* Lone Star						
44	Diamond Queen	George Wooley: 1918	$W\frac{1}{2}$(?) 34	20	7	C	
45	Dickey and Dreisbach prospect	E. A. Dickey and F. M. Dreisbach: 1917	$SW\frac{1}{4}$ 34	20	7	C	Disseminated and nodular ore.
	Dickey and Falck: *see* Suzy Bell						
	Dorothy	Edwin Barnham: 1918	?	22	5	D	Some low-grade ore mined.
38	Dowden	C. W. Dowden: 1918	$SE\frac{1}{4}$ 29	22	5	C	Probably worked out. Low-grade ore.
	Dynamite Kid: *see* Green Ridge						
1	Glenn prospect	J. W. Glenn: 1911	$E\frac{1}{2}SE\frac{1}{4}$ 29	25	4	C	Several small lenses of ore mined.
	Graham-King lease: *see* Section 35						
30	Green Ridge	Loren Babcock: 1949	$SE\frac{1}{4}NW\frac{1}{4}$ 4	21	4	C	
	Happy Hollow: *see* April Fool						
29	Hendricks No. 1	Chas. and Wm. Hendricks: 1917	31	22	4	C	Location uncertain.
31	Hendricks No. 2	Wm. Hendricks: 1918	$NE\frac{1}{4}$(?) 6	21	4	C	Mostly concentrating ore.
27	Hendricks prospect	do.	$SE\frac{1}{4}$ 27	22	4	D	Small prospect.
	Iron Point: *see* Park's Ranch						

10	King prospects	Jack Koterske: 1948	$N\frac{1}{2}NE\frac{1}{4}$ 1	22	4	C	Small prospects.
16	Do.	W. H. King: 1918	$NW\frac{1}{4}$ 32	23	5	C	Small prospect.
15	Do.	do.	$NW\frac{1}{4}NE\frac{1}{4}$ 6	22	5	D	Float only.
3	Lambert	George Lambert: 1950	$SW\frac{1}{4}NW\frac{1}{4}$ 2	22	3	A	Most promising deposit in county.
26	Liberty Bond	J. C. Akin: 1918	$SW\frac{1}{4}$ 8	22	5	D	
	Liberty group: *see* War Bond group						
	Lime Saddle: *see* Park's Ranch						
	Little Butte: *see* Lambert?						
	Little Corbett: *see* Section 35?						
17	Little Hope	J. H. Brassell: 1944	NE cor. 6	22	5	C	
28	Lockridge	J. D. Lockridge: 1949	$NE\frac{1}{4}SE\frac{1}{4}$ 28	22	4	C	Worked out.
39	Lone Star	L. A. Pope: 1943	$NE\frac{1}{4}$ 10	21	6	C	Probably worked out.
8	Lucky Bill	W. H. King: 1918	$SW\frac{1}{4}NE\frac{1}{4}$ 36	23	4	C	Worked out.
	Lucky Strike: *see* Suzy Bell						
	Lumber T.: *see* Lambert						
19	Mary Jane	J. H. Brassell: 1944	$NW\frac{1}{4}$(?) 31	23	6	C	Location uncertain.
	Midget: *see* Big Pine?						
	Mill Creek: *see* Big Pine						
34	Miller and/or Mountain of Chrome	R. E. Miller: 1942	$SE\frac{1}{4}SW\frac{1}{4}$ 30	22	5	D	Small lenses of concentrating ore.
35	Do.	do.	$SW\frac{1}{4}SE\frac{1}{4}$ 30	22	5	D	Small lenses of concentrating ore.
	Nevera: *see* Simmons						
	Norris and Noyes: *see* Big Bend, Swayne						
41	North Star	G. A. Will: 1936	$NE\frac{1}{4}SW\frac{1}{4}$ 21	20	7	C	Probably worked out.
5	Parkeson	A. M. Glover and R. Parkeson: 1943	$SE\frac{1}{4}SE\frac{1}{4}$ 20	23	4	C	
33	Park's Ranch	F. H. Park: 1943	$S\frac{1}{2}NE\frac{1}{4}$ 7	21	4	B	May warrant additional exploration.
43	Powell	E. B. Powell: 1918	35	20	7	C	
49	P. U. P.	G. W. Usher and G. W. and C. H. Peterson: 1943	$SE\frac{1}{4}$ 6	19	7	A	
	Red Mountain: *see* North Star?						
13	Reynolds No. 1	Jack Koterske: 1948	$NE\frac{1}{4}SE\frac{1}{4}$ 1	22	4	C	Workings flooded.
14	Reynolds No. 2	?	$NE\frac{1}{4}SE\frac{1}{4}$ 6	23	4	C	Worked out.
37	River Side	J. C. Akin: 1943	$NW\frac{1}{4}$ 32	22	4	C	Worked out.
21	Section 13	J. K. Mezker: 1946	$NE\frac{1}{4}$ 13	22	5	C	Mostly concentrating ore.
7	Section 35	Southern Pacific Land Co.: 1949	$SW\frac{1}{4}NE\frac{1}{4}$ 35	23	4	B	Some disseminated ore remains.
6	Simmons	L. R. Stokes: 1918	$S\frac{1}{2}SW\frac{1}{4}$ 26	23	4	C	
	Sourdough: *see* Glenn						
	Southern Pacific: *see* Section 13						

Table 13. Alphabetical list of chromite mines and prospects in Butte County, California—continued

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Sterling City: *see* Glenn?						
	Stevens (Stephens): *see* Park's Ranch						
12	Stewart mine	Jack Koterske: 1948	SE¼NE¼ 1	22	4	C	Probably worked out.
11	Stokes prospects: *see* also Stewart	do	NE¼SW¼ 1	22	4	C	Small prospects.
50	Strouse (Strauss)	Mrs. M. E. Strouse: 1909	NE cor. 7	19	7		Production, if any, not known.
	Sunnyslope: *see* Simmons						
46, 47	Suzy Bell	A. G. Arbucco, Warren and G. W. Tinsley: 1943	E½W½ 4	19	7	B	Probably worked out.
25	Swayne	Swayne Lumber Co.: 1918	NE¼ 9	22	5	B	Planar-banded disseminated ore.
32	Taylor	George Taylor: 1918	SE¼ 6	21	4	C	Concentrating ore.
	The Gray Boy: *see* Taylor						
9	Twin Cedars	G. C. Rohrer and Jess McCrosky: 1918	SE¼ 36	23	4	C	Worked out.
	Wa-ehamma Tunnel: *see* Lambert						
20-23	War Bond group	J. A. Clark: 1943	1, 2, 11, 12	22	5	C	Small prospects on low-grade ore.
36	War Eagle	Southern Pacific Land Co.: 1949	NE¼NW¼ 31	22	5	D	Large deposit of concentrating ore.
	Wells: *see* Green Ridge						
	Western Ore Co.: *see* Hendricks No. 2						
	Wilson	Otto Bendt: 1918	?	20	7		Production, if any, not known.
	Winters: *see* Twin Cedars or Lucky Bill						
	Yellow Jacket: *see* North Star						
	Zenith: *see* P. U. P.						
48	Unknown	Unknown	NE¼ 5	19	7	D	Few tons low-grade ore piled.

* A, 1,000 tons or more; B, 150-1,000 tons; C, less than 150 tons; D, no ore shipped.

Table 14. Alphabetical list of chromite mines and prospects in Nevada County, California

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
24	Alta Hill	L. W. Williams: 1937	Cent. 22	16	8	B	Sorted out best of disseminated ore.
27	Baker prospect	(?) Baker: 1918	NE¼ 26	16	8	D	Prospects on disseminated ore.
11	Bartholomew-Simms lease	Swedish-American Bank: 1918	NE¼ 7	16	11	C	
34	Bowden prospect	Mrs. L. A. Bowden: 1918	SW cor. 3	15	8	D	Concentrating ore.
14	Champion mill	Carl P. Jones: 1936	On line 11-12	16	8		Concentrated chromite in 1918.
22	Codd prospects	A. A. Codd and H. B. Skewes(?): 1918	NE¼ 21	16	8	D	Concentrating ore.
26	Davey prospect	J. Davey & Son: 1918	NW¼ 26	16	8	C	Very small lens mined. Some float.
33	Dickerson	L. Dickerson Estate: 1918	N½N¼ 4	15	8	C	Several small lenses of ore found.
32	Dorsey and Ridge claims	L. V. Dorsey and D. R. Ridge: 1918	N½ 6	15	8	D	50-55 tons of ore (low-grade) mined.
18	Eden	Charles Eden: 1918	E½ 10	16	8	C	Low-grade massive ore.
4	Flintlock	Henry Adams: 1942	NW¼ 1	17	10	D	Small lenses of low-grade ore.
30	Geach	T. R. Geach: 1918	NW¼(?) 25	16	8	C	
3	Gillis prospect	C. A. Gillis: 1918	NW¼(?)NW¼ 1	17	10	C	Ore said to contain 62% Cr_2O_3.
29	Golden Gate	Golden Gate Mining Co.: 1918	NE cor. 26	16	8	D	Prospected small stringers of ore.
25	Grass Valley Extension	L. W. Williams: 1937	SE¼ 22	16	8		
42	Half Chrome	E. H. Thompson: 1918	S½SW¼ 4	14	8	B	Sorted out best of disseminated ore.
	Hoeft lease; *see* Sherman Ranch						
23	Holseman	J. H. Holseman: 1918	Cent. 22	16	8	B	Sorted out best of disseminated ore.
31	Hooper prospect	A. E. Hooper: 1918	19	16	9	D	Prospected small stringer of ore.
	Jenkins lease; *see* Davey						
	June Bug	Unknown	?				Located in Washington area.
	Limekiln; *see* Half Chrome						
	Lowell Hill; *see* Maguire						

Table 14. Alphabetical list of chromite mines and prospects in Nevada County, California—continued

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Lucky Bluff: *see* Moscatelli No. 2						
	Lucky Bob	Andrew Fogarty: 1918	?			D	Located in Lowell Hill area.
	Lucky Friday: *see* Moscatelli No. 2						
12	Maguire prospect	Lowell Hill Gold Mines: 1918	E½SW¼ 8	16	11	C	
17	Merrifield	Albert Merrifield: 1918	SW¼ 11	16	8	C	Sorted out best of disseminated ore.
5	Moscatelli No. 1	Robert Moscatelli: 1918	N½SW¼ 1	17	10	C	
2	Moscatelli No. 2	Robert Moscatelli: 1944	N½(?) 36	18	10	C	
	Moulton prospects: *see* Schmidt, Weisgien, and Rolpholm Ranch						
	Mount Hill: *see* Victory						
20	Muleahy prospect	Muleahy Bros.: 1918	16	16	8	C	
	Nevada County Chrome Co.: *see* Waite, Merrifield						
36	Numitor	Pusheck Estate: 1918	NE¼(?) 14	15	9	D	Float only.
10	Olsen prospect	Karl Olsen: 1918	NE¼ 24	17	10	D	
13	Onstomah mill	Rachel Moore et al.: 1936	On line 1-12	16	8		Concentrated chromite in 1918.
	Platz prospect	Mrs. E. M. Platz: 1918	?			C	
19	Porter	J. C. Porter: 1918	N½NE¼ 16	16	8	B	Sorted out best of disseminated ore.
	Raab prospect	Fred Raab: 1918	?			C	
7	Rapid Fire	Williamson Bros. and C. M. Cole: 1918	SW¼ 12	17	10	C	
8	Red Ledge	T. B. Williamson, C. M. Cole, and E. A. Langford: 1949	NW¼NE¼ 13	17	10	A	May warrant additional exploration.
	R.F.D. No. 1: *see* Bowden						
39	Rolpholm Ranch	Mrs. Rolph: 1942	N½ 28	15	9	C	Mostly disseminated ore.
37	Schmidt	G. A. Schmidt: 1918	SW¼ 21	15	9	C	Very small lenses. Worked out.
	Schmidt (Smith) lease: *see* Porter						
31	Section 19 prospects: *see* also Hooper	Williamson Bros. and C. M. Cole: 1918	19	16	9	D	Float.
15	Sherman Ranch	Isabelle C. Sherman: 1918	SW¼SE¼ 11	16	8	C	Mostly concentrating ore.

35	Shrull prospect	J. H. Shrull: 1918	E½SW¼NW¼ 17	15	9	D	Float only.
40	Sleeman	Sleeman Bros.: 1918	N½(?) 32	15	8	D	
	Snyder	Henry Snyder: 1941	(?) 15	16	8	B	Location uncertain.
28	Spring Hill	Spring Hill Gold Mines, Inc.: 1941	S½SE¼ 23	16	8	C	Prospects poor.
21	Standard	Hennessy Estate: 1941	NE¼(?) 21	16	8	C	
43	Sweet Ranch	John Sweet: 1918	SE¼ 4	14	8	B	Some concentrating ore remains.
41	Thompson Ranch	Herman Thompson: 1918	E½(?) 5	14	8	C	Location uncertain.
44	Tomkin lease	Unknown	NE¼NE¼ 18	14	8	C	
6	Turtledove Chrome	Walter Niles, Fred Miller, and H. O. Kohler: 1918	NE¼(?)SW¼ 1	17	10	C	
9	Victory	A. Schwartz: 1942	SE¼ 13	17	10	C	
16	Waite	B. C. Waite: 1941	E½SW¼ 11	16	8	B	Concentrating ore.
38	Weisgien	Jacob Weisgien: 1918	SW¼ 21	15	9	C	Mostly disseminated ore.
	White: *see* Waite						
	Williams: *see* Alta Hill						
1	Williamson and Cole claim	Williamson Bros. and C. M. Cole: 1918	S edge(?) 25	18	10	C	Location uncertain.
	Woil: *see* Spring Hill?						
	Wolf: *see* Half Chrome						
	Yue lease: *see* Sweet Ranch						

* A, 1,000 tons or more; B, 150-1,000 tons; C, less than 150 tons; D, no ore shipped.

Table 15. Alphabetical list of chromite mines and prospects in Placer County, California

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Alta Spaulding	M. Wortel: 1918	?			C	Located in Dutch Flat area?
	American: *see* Green						
	Americus: *see* Green						
	Anderson Hill	Capital Co. (mineral rights): 1949	N½(?) 19	15	11	C	Exact location uncertain.
	Auburn Chrome: *see* Parker Ranch						
	Bay Tree: *see also* Bunker	L. G. Embree: 1943	(?) 20	14	11	D	Exact location uncertain.
1,2	Bear River Chrome	Pacific Gas and Electric Co.: 1949	NE¼NW¼ 19	16	11	B	May warrant additional exploration.
5	Beat	D. J. Sullivan: 1949	NW cor. lot 18 6	15	11	B	Warrants additional exploration.
	Becky: *see* Bear River?						
	B.B.: *see* Bee Bee						
38cd	Bee Bee	L. J. Dunn: 1941	S½SW¼SE¼ 30	15	11	C	
	Belcher	Leo C. Davis: 1942	(?) 30	15	11	X	No detailed information available.
	Bell: *see also* Garrison, G. H.	G. H. Garrison: 1918	8, 9	14	11	C	
40	Bessie B.	Victory Chrome Co.: 1944	S½SW¼SE¼ 30	15	11	C	May warrant additional exploration.
	Bettie	Lillian M. Carlson: 1942	SE¼ 32	15	11	X	No detailed information available.
90	Black Arrow Ranch	Black Arrow Ranch Co.: 1918	S½(?) 16	13	8	B	
	Black Bear: *see* Sunset?						
	Black Butte: *see* Beat						
	Black Cat: *see* Lightning Ridge No. 2						
1	Black Nugget	Jack H. Hancock: 1942	SE cor. SW¼ 18	16	11	C	Part of Bear River Chrome?
79	Black Rock Chrome	R. F. Craig and O. H. Jones: 1918	SW cor. 36	14	11	C	Probably worked out.
	Black Sheep	Ed DeKruse or Power Timber Co.: 1918	19	15	11	C	May be same as Section 19?
81	Black Streak	Willis D. Parker and Wm. N. Kelley: 1942	N½NE¼SE¼ 2	14	9	D	Prospected float.
38cd	Blue Bell	L. J. Dunn: 1941	S½SW¼SE¼ 30	15	11	C	
	Blue Bird: *see* Bunker						
34a?	Blue Jay	V. S. Marall: 1942	SW¼ 30	15	11	C	
	Bobo	Jay Hutch: 1942	E½W½(?) 30	15	11	C	Exact location uncertain.
41	Boiler Pit	Capital Co. (mineral rights): 1949	SE¼SW¼ 29	15	11	A	Warrants additional exploration.

	Bowers and Drummond: *see* Poco Tiempo Quartz						
	Bowers and House: *see* Buttercup Chrome						
87?	Buckhorn	W. G. DeWitt, A. A. Smart, and G. B. Burnham: 1942	18	13	10	X	No detailed information available.
82	Bugg	Charles E. Bugg: 1918	E½(?) 21	14	9	C	Worked out.
	Buick "6": *see* Sunset *or* Kidder Pit?						
67,68	Bunker	Herman Schermier: 1950	S½SE¼ 20	14	11	A	Warrants additional exploration.
	Butler's Camp: *see* Boiler Pit						
72	Buttercup Chrome	F. R. Bowers and M. D. House: 1918	NE¼ 30	14	11	B	Probably worked out.
33a	Buzzard	V. S. and H. R. Marall: 1943	S½NW¼SW¼ 30	15	11	C	
34b	Do	Do.	S½NE¼SW¼ 30	15	11	C	
	Capital Company (CAPCO)	Capital Co.: 1949	Various	15	11		Holds mineral rights to secs. 16, 17, 19, 21, and 29, and to parts of secs. 5, 7, 8, 15, 18, 20, 28, 31, and 32, T. 15N., R. 11 E.
51	Capp's Pit	Capital Co. (mineral rights): 1949	SE¼SW¼ 29	15	11	C	
	Casa Loma: *see* Beat						
	Cat Nip	G. A. Muller and M. T. Mathews: 1942	?			X	Location not known.
	Central Pacific lease: *see* Bear River						
	Chocho: *see* Chucho						
	Chrome	Edward Gaylord and J. B. Landis: 1918	?			C	May be in El Dorado Co.
32	Chrome No. 5	Unknown	NE¼SE¼NE¼ 30	15	11	D	Location work only?
78	Chrome Divide	A. H. Bayes: 1942	S edge 31	14	11	C	
	Chrome Dyke	Blanche Hamilton: 1942	?			X	Location not known.
	Chrome Lode	G. E. Gorman and Alfred and Bonnie Hansen: 1942	30	15	11	X	No detailed information available.
	Chrome Queen	T. V. Watters: 1942	?			X	Location not known.
	Chromite	Loraine J. Buell: 1942	E½ 30	15	11	X	No detailed information available.
75	Chromite	Frank O. Smith: 1918	NE¼(?) 29	14	11	C	Probably worked out.
35ab	Chucho	Ralph Deeds, George Bennett, and R. A. Fones: 1942	NE¼SW¼ 30	15	11	C	Worked out.
75	Clinton Burro	Frank O. Smith: 1918	NE¼(?) 29	14	11	C	Probably worked out.
69	Coal Pit: *see also* Bunker	L. G. Embree: 1943	SE¼SW¼ 20	14	11	C	
21c	Comeback	J. G. Anderson: 1949	E½NW¼SW¼ 20	15	11	D	Prospected float.
	Cortez	Unknown	?			X	Owner and location not known.
	Crittenden's CAPCO lease	Capital Co. (mineral rights): 1949	19, 29, 31, 32	15	11	C	

Table 15. Alphabetical list of chromite mines and prospects in Placer County, California—continued

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Cultus Quartz Lode	Ed DeKruse: 1941	29	14	11	D	But little chromite found.
39	Daisy Bell	J. Del Mue, Ralph Deeds, and George Bennett: 1949	S edge SE¼ 30	15	11	B	Warrants additional exploration.
54a	Dart and Braden's CAPCO lease	Capital Co. (mineral rights): 1949	31, 32	15	11		See Green's CAPCO lease, No. 54a.
31	Dart and Braden's mill site: *see* Horseshoe						
	De Kruse	Ed De Kruse: 1918	S½ 30	15	11	C	May be same as Sunny Ridge?
	Del Mue: *see* Sunset						
	Diana	G. B. Burnham: 1943	(?) 18	13	10	C	Location uncertain.
84	Dodds Ranch: *see also* Farmer	J. G. Dodds et al.: 1918	Cent. 12	13	9	D	Prospect on low-grade ore.
	Doodle Bug	G. A. Muller and M. T. Mathews: 1942	NE¼ 8	11	11	X	No detailed information available.
	Duffey lease	Mayflower Gravel Mining Co.: 1918	(?) 30	14	11	C	Location uncertain.
8	Dunbar lease	U. S. Forest Service (?): 1949	E edge lot 3, 6	15	11	C	Found only float chromite.
46?	Dunn's CAPCO lease	Capital Co. (mineral rights): 1949	SW¼SW¼ 28	15	11	C	May be same as Red Pit?
			N½NE¼ 29	15	11		
54a?	Do	Do.	NE¼NE¼ 31	15	11	C	
	Dusty Queen	Capital Co. (mineral rights): 1949	NE¼ 29	15	11	C	
	Eastside	Naomi and Myron Hardy: 1942	(?) 30	15	11	X	No detailed information available.
	East Side	Virgil Giani: 1942	SW¼SE¼ 30	15	11	X	No detailed information available.
	East Vulcan	Ida M. Macy: 1942	(?) 30	15	11	X	No detailed information available.
	Erskine	E. T. Erskine: 1918	?			C	Located in Dutch Flat area?
	Esmeralda: *see* Spanish Mines Cons.						
20	Esther and Phyllis	Capital Co. (mineral rights): 1949	W½SE¼ 19	15	11	B	Mostly residual and float chromite.
19	Esther and Phyllis mill site	do.	NE¼SW¼ 19	15	11		Concentrated detrital chromite.
	Fagg	G. L. Fagg: 1918	?			C	Located in Dutch Flat area?
84-88	Farmer property	R. H. Farmer and J. G. Dodds: 1918	12, 13, 18, 24	13	9	C	Operated by the Placer Chrome Co.

88	Fiddler's Green: *see also* Farmer	R. H. Farmer and/or J. G. Dodds: 1918	$NW\frac{1}{4}$(?) 21	13	9	C	
61-63	Finning property	Charles L. Finning, et al.: 1942	$NE\frac{1}{4}$ and $S\frac{1}{2}$ 5	14	11	C	Probably worked out.
60	Do.	do.	$N\frac{1}{2}$ and $SE\frac{1}{4}$ 6	14	11	C	Probably worked out.
	Fitzgerald and Russel lease: *see* Southern Pacific property						
	Ford and Lower: *see* Washout						
	Garrison, E. A.: *see* Spanish Mines Cons.						
	Garrison, G. H.: *see also* Southern Pacific	G. H. Garrison: 1918	8, 9	14	11		Location of several claims uncertain.
86	Gas Canyon: *see also* Farmer	R. H. Farmer: 1918	$E\frac{1}{2}NW\frac{1}{4}$ 13	13	9	C	Worked out.
	Gelch	J. A. Carlson: 1942	?	15	11	X	Location not known.
	Geisendorfer lease: *see* North Fork Chrome						
	Gore: *see also* Garrison, G. H.	G. H. Garrison: 1918	8, 9	14	11	C	Mined float chromite.
	Graves Ranch	J. A. Graves: 1918	?			D	But little chromite found.
85	Green	J. G. Dodds et al.: 1918	$SE\frac{1}{4}$ 12	13	9	C	Small lenses of low-grade ore.
49?	Green's CAPCO leases	Capital Co. (mineral rights): 1949	$SE\frac{1}{4}SE\frac{1}{4}$ 29	15	11	C	May be same as Yellow Pit.
53, 54	Do.	do.	$NE\frac{1}{4}$ 31	15	11	B	Also worked by others.
48	Do.	do.	$NE\frac{1}{4}NE\frac{1}{4}$ 32	15	11	C	Exact location not known.
52	Do.	do.	$SW\frac{1}{4}NW\frac{1}{4}$ 32	15	11	C	Exact location not known.
	Happy Family	J. G. Anderson: 1942	$W\frac{1}{2}$(?) 20	15	11	D	Location uncertain.
	Harrietta	J. G. and L. E. Anderson: 1942	$W\frac{1}{2}$(?) 20	15	11	D	Location uncertain.
58	Hayes Chrome	Charles L. Finning et al.: 1942	N edge 5	14	11	C	
	Hazel: *see also* Hewes and Jones	W. F. Hewes: 1918	5	14	11	C	Mined float chromite.
83	Hepburn	G. C. Hepburn: 1918	$SW\frac{1}{4}SE\frac{1}{4}$(?) 5	13	9	C	A little float chromite found.
	Hewes and Jones claims	W. F. Hewes and O. H. Jones: 1918	5, 8	14	11	?	Location of several claims uncertain.
45	High-grade Pit	Capital Co. (mineral rights): 1949	$NE\frac{1}{4}SE\frac{1}{4}$ 29	15	11	C	Mostly residual and float chromite.
4	Hodge Ranch	J. R. Hodges: 1918	$NW\frac{1}{4}$ 25	16	10	B	
	Hoosier	S. S. Caples and Bonnie and Agnes H. Hansen: 1942	?			X	No detailed information available.
30, 31	Horseshoe	L. E., E. D., and J. W. Drone: 1943	$NE\frac{1}{4}NE\frac{1}{4}$ 30	15	11	C	Worked out.
	Iowa Hill Chrome: *see* Iowa Hill Cons.						
23-25	Iowa Hill Consolidated	Macy Bros.: 1943	$SW\frac{1}{4}$ 19	15	11	B	
			$NW\frac{1}{4}$ 30	15	11		
9	Iron Spring	D. J. Sullivan: 1949	W edge 5	15	11	C	Mined 8-ton chromite boulder.
	Jennie	Unknown	$NE\frac{1}{4}$ 8	14	11	X	
7	Julian	D. J. Sullivan: 1949	NW cor. 5	15	11	C	Low-grade disseminated ore.
	Junabe: *see* Snakehead						

Table 15. Alphabetical list of chromite mines and prospects in Placer County, California—continued

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Kempster and Linder: *see* Julian, Iron Spring						
56	Kidder Pit	Capital Co. (mineral rights): 1949	SW¼SE¼ 31	15	11	C	
	King: *see also* Garrison, G. H.	G. H. Garrison: 1918	9	15	11	C	
	Knob Hill: *see* West Chrome						
	Last Chance	Unknown	SW¼ 4	14	11	X	
	Lazy B.	Hoysa B. Campbell: 1942	W½(?)NE¼ 32	15	11	X	No detailed information available.
	Lehigh Canyon Patent: *see* Poco Tiempo Quartz, Buttercup Chrome						
	Leola	Mayflower Gravel Mining Co.: 1942	?	14	11	X	Location not known.
	Lightning Ridge: *see* Lightning Streak No. 1?						
37ab	Lightning Streak No. 1	J. Del Mue et al.: 1945	SE¼SW¼ 30	15	11	C	Small lenses of chromite mined.
33bde	Lightning Streak No. 2	do.	Cent. SW¼ 30	15	11	C	
	Lincoln	C. E. Bowers and W. G. Devlin: 1942	(?) 30	15	11	X	No detailed information available.
	Linder and Hodges: *see* Hodge Ranch						
	Linder and Sullivan: *see* Snakehead						
77	Little Creek	L. G. Embree: 1943	NE cor. 31	14	11	C	
57?	Little V.	R. L. Rhodes: 1944	SE¼SW¼(?) 32	15	11	C	
	Lode Development Company: *see* Victory Chrome Co.						
49	Long Pit	Capital Co. (mineral rights): 1949	SE cor. 29	15	11	C	
	Lookout: *see also* Garrison, G. H.	G. H. Garrison: 1918	?	14	11		Location not known.
76	Lucky Boy	W. F. Bettencourt: 1942	29	14	11	D	
	Lucky Boy	J. A. Carlson: 1942	SW¼(?)SW¼ 32	15	11	X	No detailed information available.
22	Lucky Hunter	J. Del Mue: 1943	SW¼ 20	15	11	C	Worked out.
80	Lucky Strike	McFadden, Fitzgerald, and Berard: 1942	W edge(?) 6	13	11	C	Location uncertain.
	Lucky Strike	G. A. Muller and M. T. Mathews: 1942	SW¼ 4	14	11	X	No detailed information available.

12	Lucky Strike	Unknown	Cent. 6	15	11	C	Owner not known.
82	Major prospect	E. N. Major: 1918	E½(?) 21	14	9	D	Float only.
	Manzanita: *see* Mountain View						
53a	Maralls' CAPCO leases	Capital Co. (mineral rights): 1949	NE¼NE¼ 31	15	11	C	Mostly residual and float chromite.
53b	Do.	do.	SE¼NE¼ 31	15	11	C	Mostly residual and float chromite.
54	Do.	do.	SW¼NE¼ 31	15	11		See Green's CAPCO lease, No. 54a.
	Marigold	C. W. Doherty and E. Morris, Jr.: 1949	SW cor.(?) 30	14	11	D	10 tons of ore (low-grade?) mined.
	Mastel's CAPCO lease	Capital Co. (mineral rights): 1949	S½NE¼ 19	15	11	C	
	McCormick: *see* Beat						
	McCoy	P. H. McCoy, E. V. Rosa, W. H. Russell, and T. L. Schwab: 1918	?			X	May be same as Iowa Hill Cons.?
	McInnis prospect	John McInnis: 1917	?			D	Location not known.
	McNear Chrome: *see* Parker Ranch						
	Meadowbrook Ranch: *see* Parker Ranch						
	Mes Pah (Mizpah): *see* Sunset						
82	Meyer	Fred Meyer: 1918	E½(?) 21	14	9	C	Worked out.
	Morgan Extension	Mary S. Birnie: 1942	1	15	10	D	No detailed information available.
70	Mountain View Group	Ben Schuler: 1950	SW¼SW¼ 20	14	11	C	May warrant additional exploration.
	Muller and Mathews lease: *see* Southern Pacific property						
	Mystery	A. H. Bayes: 1943	20	15	11	C	Location uncertain.
	Mystery	McCall, Craig, and Burke: 1918	?			C	Near Michigan Bluff.
	New Hope: *see also* Hewes and Jones	W. I. Hewes and O. H. Jones: 1918	5	14	11	C	Probably worked out.
	New Year group (Nos. 1-8)	M. B. Scott: 1942	?	14	11	X	Location not known.
15	North Fork Chrome	Southern Pacific Land Co.: 1943	SE¼NW¼ 7	15	11	B	Probably worked out.
10	Oak Patch	D. J. Sullivan: 1949	W edge 5	15	11	C	Worked out.
	Occidental Minerals, Inc	J. W. Patterson: 1940	?				No detailed information available.
89	Parker Ranch	Herman Oest: 1950	S½NE¼ 17	13	8	B	High-iron concentrating ore.
62?	Pitt: *see also* Hewes and Jones	W. I. Hewes and O. H. Jones: 1918	5	14	11	C	Worked out.
73	Poco Tiempo Quartz	F. R. Bowers and E. W. Drummond: 1918	SW¼ 30	14	11	C	Probably worked out.
29	Port Wine	L. E., E. D., and J. W. Drone: 1943	NE cor. 30	15	11	C	Worked out.
	Power Timber Company	H. T. Power: 1931. Capital Co. (mineral rights): 1949	Various	15	11		

Table 15. Alphabetical list of chromite mines and prospects in Placer County, California—continued

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Pugh's CAPCO lease	Capital Co. (mineral rights): 1949	NE¼NE¼ 31 and part of W½ 32	15	11	X	
28	Randall Consolidated	D. O. Randall: 1942	NW¼NE¼ 30	15	11	C	A little float remains.
	Randall Nos. 1 and 2: *see* Randall Cons.						
46	Red Pit	Capital Co. (mineral rights): 1949	SW cor. 28	15	11	C	Residual concentrating ore.
	Rubberboot	E. D. Drone: 1942	(?) 30	15	11	C	Location uncertain.
66	Schermeir prospect	Wm. Hoffman: 1950	E edge 21	14	11	C	Worked out.
	School Mom	Mrs. Fred Lester: 1942	30	15	11	X	No detailed information available.
6	Scott	George Scott: 1917	NW cor. lot 19, 6	15	11	B	May warrant additional exploration.
17	Section 19	Capital Co. (mineral rights): 1949	NE¼NW¼ 19	15	11	B	Some ore remains in workings.
	Section 24	T. L. Schwab: 1918	24	15	11	C	Exact location uncertain.
	Shamrock	Alfred Hansen, Jake Caples, and R. C. Bowers: 1942	?			X	No detailed information available.
16	Smith and McCollum prospect	H. A. Smith and Bruce McCollum: 1941	NW cor. 18	15	11	D	
	Smith and McCollum's CAPCO lease	Capital Co. (mineral rights): 1949	Parts of E½ 31	15	11	B	Mined several deposits.
11	Snakehead	D. J. Sullivan: 1920	Lt. 27, 6	15	11	C	Probably mined out.
	Snow: *see also* Hewes and Jones	W. I. Hewes: 1918	8	14	11	C	Mined float chromite.
64,65	Southern Pacific property	Southern Pacific Land Co.: 1944	NW¼ 9	14	11	B	Float and small lenses of chromite.
	Spanish: *see* Spanish Mines Cons.						
74	Spanish Mines Consolidated	E. A. Garrison: 1918	SE cor. 25	14	10	C	Probably worked out.
	Storm Wrath	G. E. Gorman and Bonnie Hansen: 1942	(?) 30	15	11	X	No detailed information available.
22	Sugar Lump	Jay Hutch and T. C. Green: 1942	SW¼ 20	15	11	D	
	Sugar Pine Chrome	R. C. Turner, et al.: 1918	19, 20, 29, 31	15	11		See text for details.
	Sullivan Chrome: *see* Bear River						
	Sullivan-Hemphill-Nobel: *see* Bear River						
33c	Sunny Ridge	J. Del Mue et al.: 1944	NE¼SW¼SW¼30	15	11	C	Some ore remains in pit.
36	Sunny Ridge Fraction	J. Del Mue et al.: 1942	N½SW¼SE¼ 30	15	11	C	
	Sunnyside: *see also* Bunker	L. G. Embree: 1943	(?) 20	14	11	D	Exact location uncertain.
54b,55	Sunset	C. L. Mathews: 1945	N½SE¼NW¼ 31	15	11	B	Warrants additional exploration.
	Swarts and Du Bois: *see* Major						

	Swares and Du Bois: *see* Major						
	Tip Top	G. A. Muller and M. T. Mathews: 1942	?			X	Location not known.
	Tout Va Bien	G. E. Gorman and C. E. Bowers: 1942	(?) 30	15	11	X	No detailed information available.
	Trouble	Capital Co. (mineral rights)?: 1949	NE¼SE¼(?) 31	15	11	X	No detailed information available.
	Turner, R. C.: *see* Sugar Pine Chrome						
	Turner and Geisendorfer Chrome and Concentrator Company	R. L. Turner and C. A. Geisendorfer: 1919	20, 30, 31, 32 and 5	15 14	11 11		See text for details.
37b	Turner and Geisendorfer mill site	Do.	SW¼SE¼ 30	15	11		Concentrated fines and residual ore.
50	Twin Shafts	Capital Co. (mineral rights): 1949	SW¼SE¼ 29	15	11	C	Probably worked out.
3	Uvarovite	Charles Kempster and R. E. Linder: 1918	SE¼ 24	16	10	C	
	Victory Chrome Company	C. H. Brown, Jerry Grant, and Ray Graetz: 1944	5, 6, 20 and 19, 20, 28, 29, 30, 32	14 15	11 11		See text for property owners and details.
47	Victory Chrome Company mill site	Capital Co. (mineral rights): 1949	SW cor. 28	15	11		Concentrated residual chromite.
	Vivian	Andrew Carlson: 1942	S½SE¼ 32	15	11	X	May be same as Hayes.
26?	Vulcan Consolidated	Macy Bros.: 1943	(?) 30	15	11	C	Location uncertain.
	War Metals Development Company: *see* Esther and Phyllis						
71	Washout	G. S. Ford, J. S. Lower, and B. Myers: 1944	NE¼NW¼ 30	14	11	B	
	Weiler's CAPCO lease	Capital Co. (mineral rights): 1949	Parts of E½ 31	15	11	X	
14	West Chrome	H. A. and C. A. Geisendorfer: 1942	NW cor. NE¼ 12	15	10	B	Small stringers of chromite left.
13	West prospect	W. N. West: 1918	S½ 1	15	10	D	
35c, 37e, 38a	Wild Canyon	J. Del Mue, et al.: 1942	E½SE¼SW¼ 30	15	11	C	
	Wild Cat	George Bennett, Ralph Deeds, and R. A. Fones: 1941	(?) 30	15	11	X	May be same as Wild Canyon.
	Williams	J. L. Williams: 1931	?			C	Near Forest Hill?
	Williamson and Beck: *see* Iowa Hill Cons.						
49	Yellow Pit	Capital Co. (mineral rights): 1949	SE cor. 29	15	11	C	Mostly residual and float chromite.
18	Unidentified prospects	Capital Co. (mineral rights): 1949	E½NE¼ 19	15	11	D	Prospected float chromite.
21ab	Do.	Do.	NE¼SE¼ 19	15	11	D	Prospected float chromite.
42	Do.	Do.	NE¼SE¼ 29	15	11	C	
43	Do.	Do.	SE¼NE¼ 29	15	11	C	
44	Do.	Do.	E½(?)NW¼ 28	15	11	D	Prospected float chromite.
27	Unidentified prospect	Unknown	SW¼NE¼ 30	15	11	X	
59	Unidentified prospect	Mayflower Gravel Mining Co.: 1942	NW¼(?)NW¼ 5	14	11	X	

* A, 1,000 tons or more; B, 150-1,000 tons; C, less than 150 tons; D, no ore shipped; X, production not known, but some ore may have been shipped under another name.

Table 16. Alphabetical list of chromite mines and prospects in Plumas County, California

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
	Bald Mountain Nos. 1 and 2: *see* Pine Flat						
	Bear: *see* White Pine						
	Big Four	Robert Belden: 1918	?			D	Location not known.
4	Blue Jay	C. L. Gander and Tom Ormand: 1943	31, 32	26	7	D	Small prospects.
	Boss Quail	Union Chrome Co. (lessee): 1918	?			C	Location not known.
39	Bottle Springs	Frank Maurezzio and R. R. Jesky: 1943	SE¼ 17	23	9	D	Some float.
24	Cattle Springs Nos. 1 and 2	E. R. Patterson and E. V. Spivey: 1943	SW¼NE¼ 9	23	9	C	
14	Cedar Flat	Do.	SW¼ 6	23	9	C	Probably mined out.
	Chance: *see* Last Chance						
46	Chicago Nos. 1 and 2	Louis and August Eddelbuttel and J. R. North: 1943	S½ 36	23	9	C	
28	Clover Leaf	George Maxwell: 1944	NE¼ 23	23	9	C	
38	Commander	Frank Maurezzio and R. R. Jesky: 1943	SE¼ 17	23	9	C	
35	Commander Extension	Do.	SE¼ 17	23	9	D	Some float.
15-17	Cough Nos. 1-3	F. G. Myers: 1943	SE¼ 8	23	9	C	Production mostly from float.
37	Deerhorn	Frank Maurezzio and R. R. Jesky: 1943	SE¼ 17	23	9	D	Some float.
36	Deerhorn Extension	Do.	SE¼ 17	23	9	D	Some float.
30	Diamond	A. A. Benner and R. E. Barrington: 1943	SW¼SE¼ 16	23	9	C	
18	Eddelbuttel	August Eddelbuttel: 1943	N½SE¼ 8	23	9	D	
	Edeline prospect	Ray Edeline: 1942	?			C	Location not known.
	Fails Hill: *see* Shennandoah						
29	Fido	August Eddelbuttel: 1943	NE¼SE¼ 16	23	9	C	15-20 tons reported on dump in 1943.
10	Florence	Harry Fuller: 1943	NE cor. 16	24	8	?	Production, if any, not known.
25	General MacArthur	Ralph E. Jordan and John Egbert, Jr.: 1943	S½ 11	23	9	D	
26	General Wainwright	Do.	S½ 11	23	9	D	
	Gifford	J. Gifford: 1918	?			C	Location not known.
	Green Ledge: *see* Horseshoe No. 2						
	Gold Stripe claim	Peerless Development Co., B. K. Melville: 1943	SE¼SE¼ 36	27	8		Production, if any, not known.
9	Hillside	Harry Fuller: 1943	NE¼ 9	24	8		Production, if any, not known.
40,41	Horseshoe Nos. 1 and 2	E. R. Patterson and E. V. Spivey: 1943	NW¼ 21	23	9	D	10 tons piled on No. 2 claim in 1943.

11	Hudson	Harry Fuller and E. R. Smith: 1943	N½ 27	24	8	C	
8	Jack Forth	Jack Forth: 1944	SW¼ 34	25	8	C	
	Jitney Nos. 1 and 2: *see* McCarty						
	King Snake: *see* Horseshoe No. 1 (?)						
44,45	Last Chance Nos. 1 and 2	August Eddelbuttel and C. W. Goodrich: 1943	NW¼ 33	23	9	C	30 tons ore on dumps.
31	Lucky Three	A. A. Benner and R. E. Barrington: 1943	SW¼SE¼ 16	23	9	D	No ore exposed. Prospects poor.
42	Mammoth	Do.	S½ 28	23	9	C	
27	McCarty Nos. 1-6	George Maxwell: 1943	Cent. (?) 14	23	9	C	Reserves may exceed 100 tons.
43	Meadows	August Eddelbuttel and C. W. Goodrich: 1943	NW¼ 33	23	9	D	
32	Oakie	A. A. Benner and R. E. Barrington: 1943	SE¼SW¼ 16	23	9	?	Production, if any, not known.
	Peerless Development Co.: *see* Poodle Dog						
	Pepper: *see* Cough						
33	Pine Cone	August Eddelbuttel: 1943	Cent. SW¼ 16	23	9	D	2 tons ore mined.
19-21	Pine Flat Nos. 1-3	E. R. Patterson and E. V. Spivey: 1943	On line 8-9	23	9	C	
2	Poodle Dog	Peerless Development Co., B. K. Melville: 1943	NE cor. 1	26	8	C	
5	Red Hill	George Maxwell: 1943	10	25	7	C	
	Ridley prospect	R. G. Ridley: 1942	?			C	Float only.
	Salt: *see* Spot						
	Salt Extension: *see* Cough						
12	Section 36	George Maxwell (shipper): 1943	NE¼(?) 36	21	8	C	
7	Shennandoah Nos. 1 and 2	August Eddelbuttel: 1943	NW¼ 25	25	7	C	Mostly low-grade ore. Some exposed.
6	Skyline Nos. 1 and 2	George Maxwell: 1943	10	25	7	C	
	Snow White Nos. 1-3	Harry Fuller: 1943	?				Location not known.
	Spice: *see* Cough						
3	Spillover Placer and Quartz	Albert Ziebar: 1943	6	26	9	D	Float.
23	Spot	E. R. Patterson and E. V. Spivey: 1943	NW¼NE¼ 17	23	9	C	
	Tip Top	Joseph L. Fiosic: 1918	?	24	8	D	Location not known.
	Valley View	W. B. Boyden and Fred Koenig: 1918	(?)21	26	9	D	Probably a manganese deposit.
34	White Fir	A. A. Benner and R. E. Barrington: 1943	NW¼SW¼ 16	23	9	C	
22	White Pine	E. R. Patterson and E. V. Spivey: 1943	NE¼NE¼ 17	23	9	B	May warrant additional exploration.
1	Wolf Creek	Mrs. Cassie M. Hamilton: 1936	SW¼SE¼ 36	27	8	B	30 tons low-grade ore on dumps.
	Unknown (Meadow Valley)	George Maxwell (shipper): 1941	?			C	Location not known.
	Unknown (Onion Valley)	Unknown	?			C	Location not known.

* A, 1,000 tons or more; B, 150-1,000 tons; C, less than 150 tons; D, no ore shipped.

Table 17. Alphabetical list of chromite mines and prospects in Sierra County, California

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
10	Becky	Oxford Quartz Mining Co.: 1944	NE¼NE¼ 27	20	10	D	Part of Oxford.
	Big Chance: *see* Roupe(?)						
	Big Chrome: *see* Roupe(?)						
15, 16	Brandy City	D. E. Luce and Co.: 1909	SE¼(?) 1	19	8	C	Probably worked out.
	Camptonville: *see* Roupe						
	Carter prospect	William Carter: 1918	?			D	20 tons (low-grade?) stocked in 1919.
	Case and Myers: *see* Oxford						
13	Casserly prospect	W. W. Casserly: 1918	E½ 29	20	10	C	
	Chrome "F", "N", etc.: *see* Dorriss						
	Chrome Nos. 1-5: *see* Gibsonville						
25	Croesus	Croesus Gold Mining Co.: 1918	5	18	10	C	Probably worked out.
	Cuffe	John Cuffe: 1942	?			C	Location not known.
23, 24	Dorriss	R. Dorriss, M. H. Davis, H. M. Bradbury, and A. M. Dobbie: 1918	SW¼SE¼ 29	19	10	C	Apparently worked out.
22	Evans prospect	Robert Evans: 1918	?	19	10	C	Probably worked out.
21	Finan (Fainine) prospect	Steven Finan: 1918	SW¼ 29	19	10	C	Worked out.
28	Flynn and Woods prospect	Flynn Bros. and J. J. Woods: 1918	SW¼(?) 6	18	10	C	Probably worked out.
1-3	Gibsonville	W. T. Baldwin, L. L. Clough, and G. W. Chamberlin: 1918	E½ 29	22	10	B	
7	Goleonda Fraction	C. A. and G. B. Winrod: 1944	SW¼NE¼ 22	20	10	C	Probably worked out.
	Gold Bluff: *see* Oxford						
	Good Hope: *see* Oxford						
11	Good Hope Extension No. 2	Oxford Quartz Mining Co.: 1944	NW cor. 26	20	10	C	Part of Oxford.
	Good Luck	Lee Jackson: 1918	?	19	9	D	10 tons (low-grade?) stocked in 1919.
17	Luce (Luse) and Co.: *see also* Brandy City	D. E. Luce and Co.: 1909	SW¼ 29	19	9	D	
	Lucky Strike	Zerga and Horwege Bros.: 1918	?			D	10 tons (low-grade?) stocked in 1921.
26	Macchaus	H. Macchaus, G. E. Redmayne, C. D. McGonigal, and S. Finan: 1918	E½(?) 5	18	10	B	Probably worked out.
27	McCormick prospect	C. Y. McCormick: 1918	E½(?) 5	18	10	C	Probably worked out.
14	Milton	R. C. Zaring or Mrs. Marie E. Phelan: 1943	SE¼ 4	19	12	B	Reserves may exceed 150 tons.

8	Mt. Holly	Oxford Quartz Mining Co.: 1944	$SW\frac{1}{4}NE\frac{1}{4}$ 22	20	10	D	Part of Oxford.
9	Oxford	do.	$SE\frac{1}{4}$ 22	20	10	B	Mostly concentrating ore.
12	Oxford Mill	do.	$SE\frac{1}{4}NW\frac{1}{4}$ 26	20	10		
	Pilot Peak	Frank Delahanty: 1918	?	22	10	D	89 tons (low-grade?) stocked in 1919.
4, 5	Poker Flat prospects	E. R. Jones and A. J. Modglin: 1942	15, 16	21	10	D	Promising float.
20	Polar	George Phippen: 1918	$W\frac{1}{2}$ 20	19	10	D	Prospects poor.
	Redmayne and McGonigal: *see* Milton						
18	Roupe	R. J. Roupe and/or W. B. Roupe: 1942	$SE\frac{1}{4}$(?) 30	19	9	B	Reserves of 50 tons reported in 1942.
	Skeyer	R. C. Turner: 1918	?			D	16 tons (low-grade?) stocked in 1919.
19	South Star	Ostrom and Lindvall Bros.: 1918	$W\frac{1}{2}$ 17	19	10	C	Probably worked out.
	Tip Top	C. D. McGonigal: 1918	?			D	Location not known.
	Whiskey Diggings	Ernest Diske: 1918	?	22	10	D	Section location not known.
6	White Bear	White Bear Mining Co.: 1942	On line 9-16	20	10	B	Ore high in Fe.

* A, 1,000 tons or more; B, 150-1,000 tons; C, less than 150 tons; D, no ore shipped.

Table 18. Alphabetical list of chromite mines and prospects in Yuba County, California

Map no.	Property	Owner (in year shown)	Location			Class by production*	Remarks
			Section	T.(N)	R.(E)		
3	Arbueco prospects	A. G. Arbueco: 1943	$SW\frac{1}{4}$ 10	19	7	D	
4	Do.	do.	$SW\frac{1}{4}$ 15	19	7	D	15-20 tons 33% ore mined.
5	Ironrite	C. A. Winrod et al.: 1942	$S\frac{1}{2}$(?) 35	19	8	C	Location uncertain. Ore high in Fe.
1	Magruder prospects	Soper-Wheeler Timber Co.: 1943	$NW\frac{1}{4}SW\frac{1}{4}$ 15	20	8	D	Few tons low-grade ore remain.
2	Do.	do.	Cent. $NW\frac{1}{2}$ 22	20	8	D	Low-grade float.
	Sharrer prospects: *see* Arbueco (No. 3)						

* A, 1,000 tons or more; B, 150-1,000 tons; C, less than 150 tons; D, no ore shipped.

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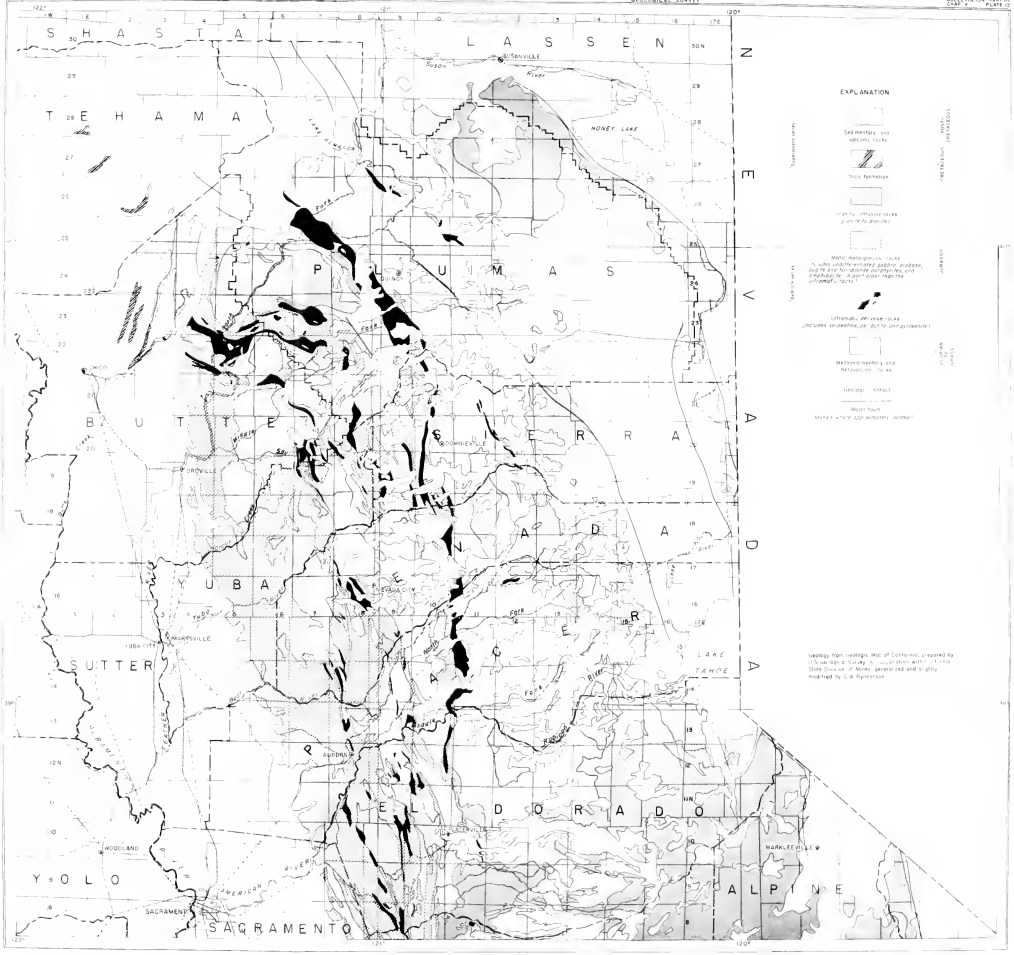
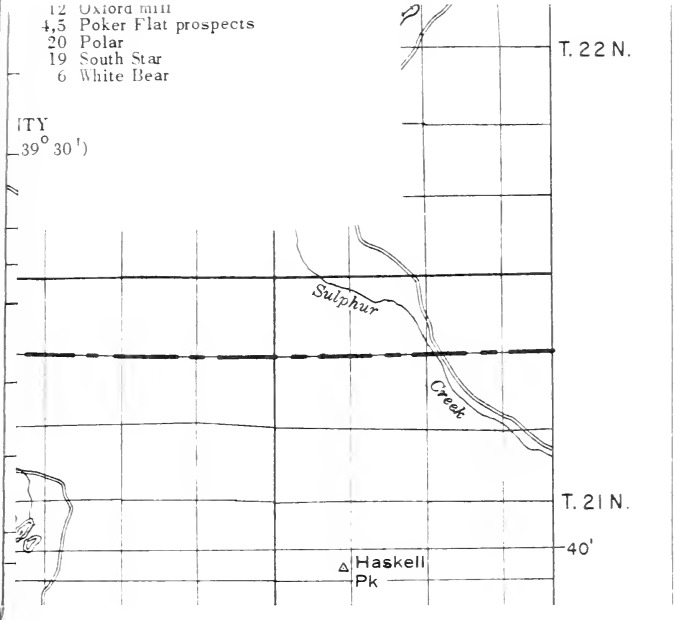


GENERALIZED GEOLOGIC MAP OF THE NORTHERN SIERRA NEVADA, CALIFORNIA

SHOWING LINEAR DISTRIBUTION OF ULTRAMAFIC ROCKS

0 10 20 30 40 50 Miles


12 Oxford mill
4,5 Poker Flat prospects
20 Polar
19 South Star
6 White Bear
ITY
39° 30')
Sulphur
Creek
T. 22 N.
T. 21 N.
40'
Haskell
Pk

DIVISION OF MINES
OLAF P. JENKINS, CHIEF

STATE OF CALIFORNIA
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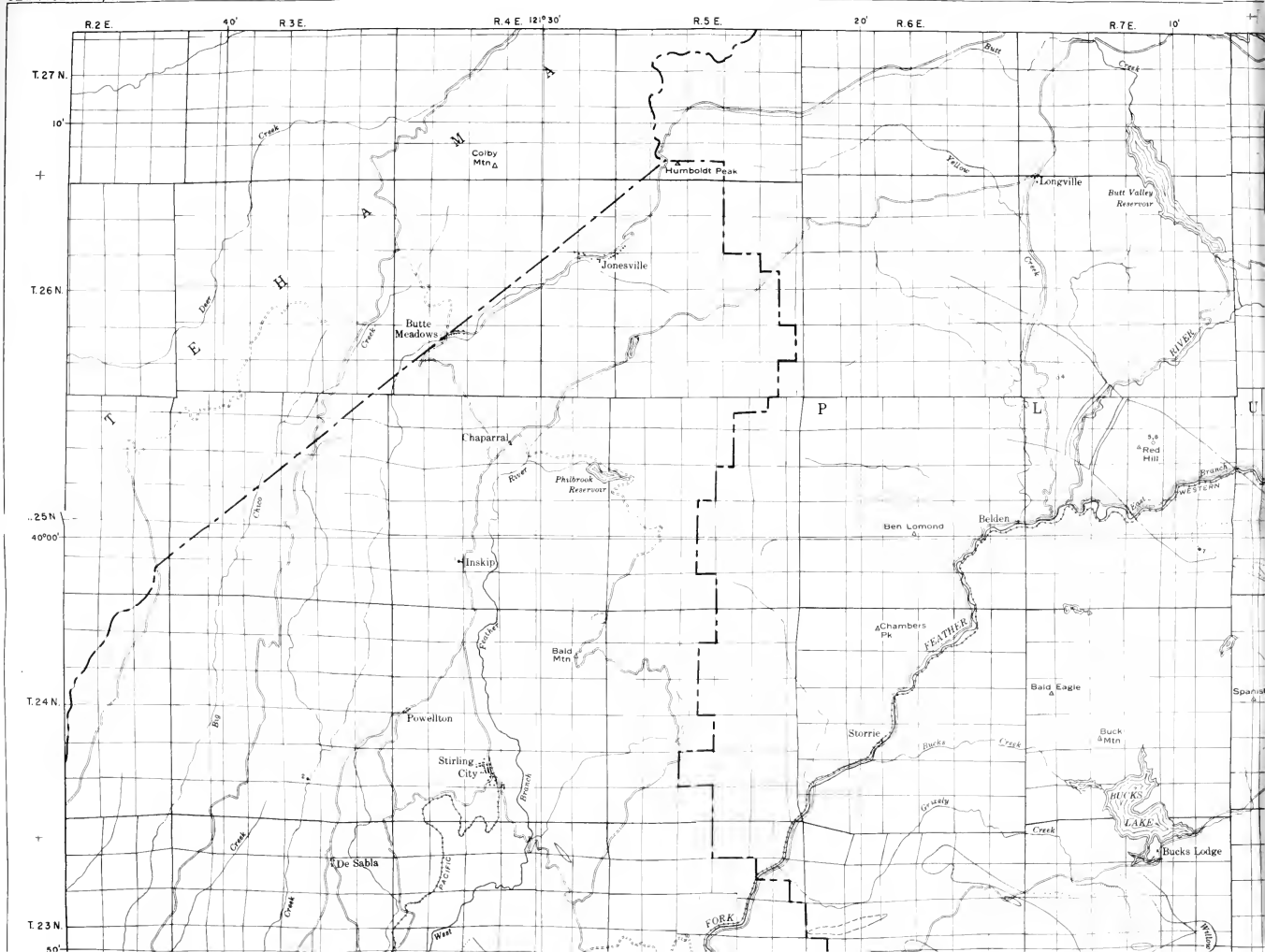
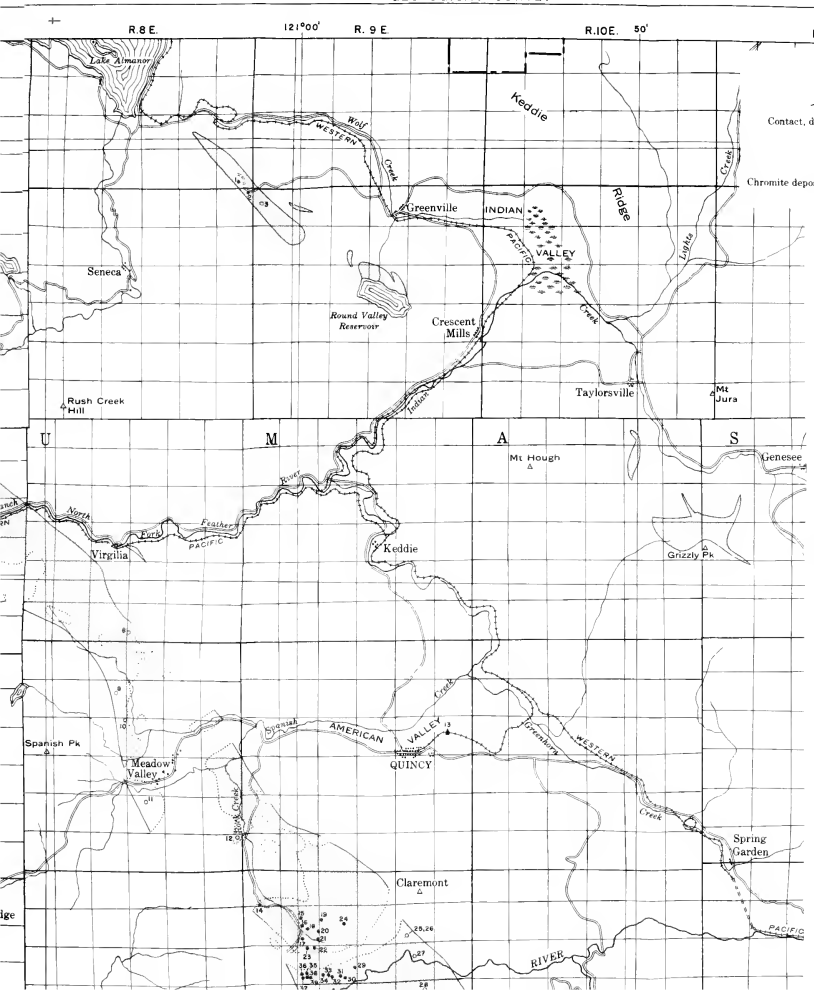
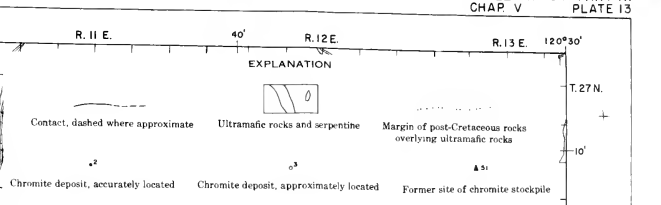






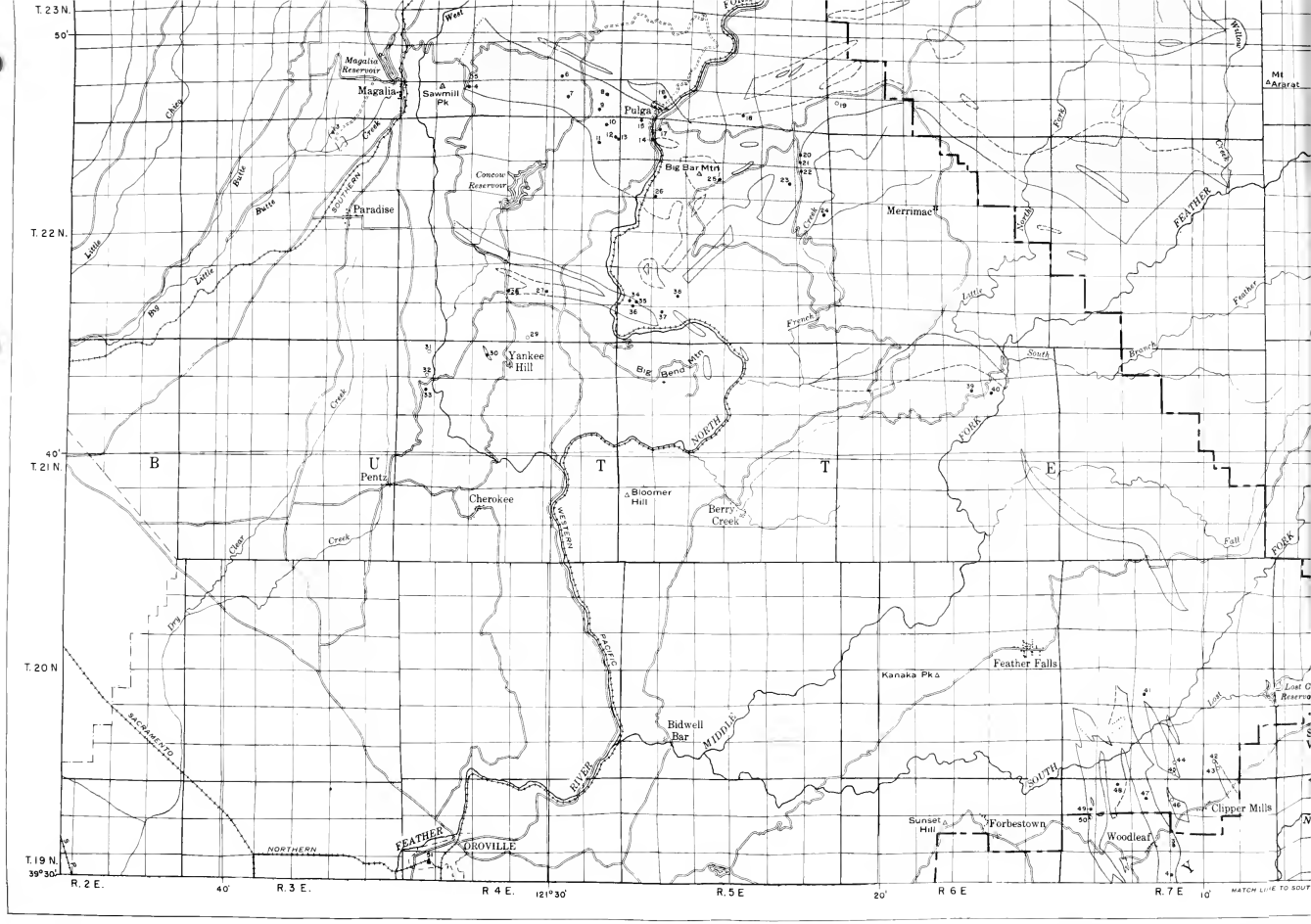
LIST OF CHROMITE PROPERTIES

BUTTE COUNTY

Numerical	Alphabetical
1 Glenn prospect	2 Anti-Axis
2 Anti-Axis	42 Bear Canyon
3 Lambert	40 Big Bend
4 Christian Place	18 Big Pine
5 Parkeson	4 Christian Place
6 Simmons	44 Diamond Queen
7 Section 35	45 Dickey and Dreisbach prospect
8 Lucky Bill	38 Dowden
9 Twin Cedars	1 Glenn prospect
10 King prospect	30 Green Ridge
11 Stokes prospects	29 Hendricks No. 1
12 Stewart	31 Hendricks No. 2
13 Reynolds No. 1	27 Hendricks prospect
14 Reynolds No. 2	10 King prospect
15,16 King prospects	15,16 King prospects
17 Little Hope	3 Lambert
18 Big Pine	26 Liberty Bond
19 Mary Jane	17 Little Hope
20-23 War Bond group	28 Lockridge
24 Section 13	39 Lone Star
25 Swayne	8 Lucky Bill
26 Liberty Bond	19 Mary Jane
27 Hendricks prospect	51 Metals Reserve Co. stockpile site
28 Lockridge	34 Miller
29 Hendricks No. 1	35 Mountain of Chrome
30 Green Ridge	41 North Star
31 Hendricks No. 2	5 Parkeson
32 Taylor	13 Park's Ranch
33 Park's Ranch	43 Powell
34 Miller	49 P. U. P. (Zenith)
35 Mountain of Chrome	13 Reynolds No. 1
36 War Eagle	14 Reynolds No. 2
37 River Side	37 River Side
38 Dowden	24 Section 13
39 Lone Star	7 Section 35
40 Big Bend	6 Simmons
41 North Star	12 Stewart
42 Bear Canyon	11 Stokes prospects
43 Powell	50 Strouse
44 Diamond Queen	46,47 Suzy Bell (Lucky Strike)
45 Dickey and Dreisbach prospect	25 Swayne
46,47 Suzy Bell (Lucky Strike)	32 Taylor
48 Unknown	9 Twin Cedars
49 P. U. P. (Zenith)	20-23 War Bond group
50 Strouse	36 War Eagle
51 Metals Reserve Co. stockpile site	48 Unknown

PLUMAS COUNTY

1 Wolf Creek	4 Blue Jay
2 Poodle Dog	39 Bottle Springs
3 Spillover Placer and Quartz	24 Cattle Springs Nos. 1 and 2
4 Blue Jay	14 Cedar Flat
5 Red Hill	46 Chicago Nos. 1 and 2
6 Skyline Nos. 1 and 2	28 Clover Leaf
7 Shenandoah Nos. 1 and 2	38 Commander
8 Jack Forth	35 Commander Extension
9 Hillside	15-17 Cough Nos. 1-3
10 Florence	37 Deerhorn
11 Hudson	36 Deerhorn Extension
12 Section 36	30 Diamond
13 Metals Reserve Co. stockpile site	18 Eddelbutel
14 Cedar Flat	29 Fido
15-17 Cough Nos. 1-3	10 Florence
18 Eddelbutel	25 General MacArthur
19-21 Pine Flat Nos. 1-3	26 General Wainwright
22 White Pine	9 Hillside
23 Spot	40 Horseshoe No. 1
24 Cattle Springs Nos. 1 and 2	41 Horseshoe No. 2
25 General MacArthur	11 Hudson
26 General Wainwright	8 Jack Forth
27 McCarty Nos. 1-6	44 Last Chance No. 1
28 Clover Leaf	45 Last Chance No. 2
29 Fido	31 Lucky Three
30 Diamond	42 Mammoth
31 Lucky Three	27 McCarty Nos. 1-6
32 Oakie	43 Meadows
33 Pine Cone	51 Metals Reserve Co. stockpile site
34 White Fir	32 Oakie
35 Commander Extension	33 Pine Cone
36 Deerhorn Extension	19-21 Pine Flat Nos. 1-3
37 Deerhorn	2 Poodle Dog
	22 White Pine

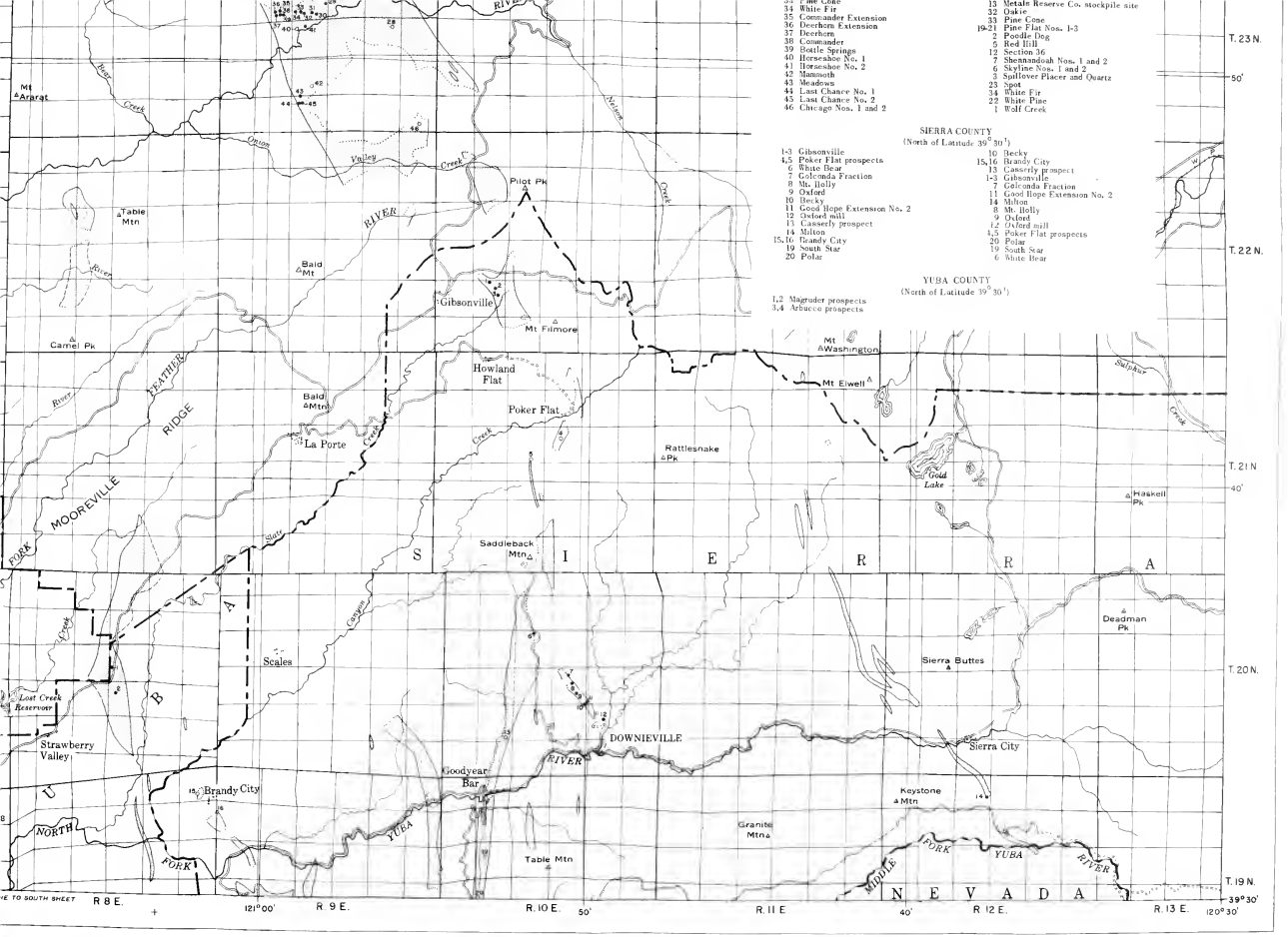


MAP OF PARTS OF PLACER, NEVADA, SIERRA, YUBA

SHOWING DISTRIBUTION OF ULTRAMAFIC ROCKS

NORTH SHE

0 ½ 1 2 3 4 5



Compiled by G. A. Rynearson, 1950

UBA, BUTTE, AND PLUMAS COUNTIES, CALIFORNIA

OCKS AND LOCATION OF CHROMITE DEPOSITS

U SHEET

DIVISION OF MINES
OLAF P. JENKINS, CHIEF

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

LIST OF CHROMITE PROPERTIES

Numerical

YUBA COUNTY

(South of Latitude 39° 30')

5 Ironrite

SIERRA COUNTY

(South of Latitude 39° 30')

17 Luce & Co.
18 Roupe
21 Finan prospect
22 Evans prospect
23,24 Dorriss
25 Croesus
26 Macchaus
27 McCormick prospect
28 Flynn and Woods prospect

NEVADA COUNTY

1 Williamson and Cole
2 Moscatelli No. 2
3 Gillis prospect
4 Flintlock
5 Moscatelli No. 1
6 Turtledove Chrome
7 Rapid Fire
8 Red Ledge
9 Victory
10 Olsen prospect
11 Bartholomew-Summs lease
12 Maguire prospect
13 Onstoman mill
14 Champion mill
15 Sherman Ranch
16 Waite
17 Merrifield
18 Eden
19 Porter
20 Mulcahy prospect
21 Standard
22 Codd prospects
23 Holseman
24 Alta Hill
25 Grass Valley Extension
26 Davey prospect
27 Baker prospect
28 Spring Hill
29 Golden Gate
30 Geach
31 Section 19 prosperts
32 Dorsey and Ridge
33 Dickerson
34 *Bowden prospect*
35 *Shrull prospect*
36 Numitor
37 Schmidt
38 Weisgien
39 Rolpholm Ranch
40 Sleeman
41 Thompson Ranch
42 Half Chrome
43 Sweet Ranch
44 Tomkin lease

PLACER COUNTY

1 Bear River Chrome
Black Nugget
2 Bear River Chrome
3 Usarovitz
4 Hodge Ranch
5 Beat
6 Scott
7 Julian
8 Dunbar lease
9 Iron Spring
10 Oak Patch
11 Snakehead
12 Lucky Strike
13 West prospect
14 West Chrome
15 North Fork Chrome
16 Smith and McCollum prospect
17 Section 19
18 Unidentified prospects
19 Esther and Phyllis mill site
20 Esther and Phyllis
21 Comeback (21c)
Unidentified prospects (21ab)
22 Lucky Hunter
Sugar Lump
23-25 Iowa Hill Consolidated
26 Vulcan Consolidated (?)
27 Unidentified prospect
28 Randall Consolidated
29 Port Wine
30 Horseshoe
31 Dart and Braden mill site
32 Chrome No. 5
33 Buzzard (33a)
Lightning Streak No. 2 (33bde)
Sunny Ridge (33c)
34 Blue Jay (34a?)
Buzzard (34b)
35 Chucho (35ab)
Wild Canyon (35c)
36 Sunny Ridge Fraction
37 Lightning Streak No. 1 (37ab)
Wild Canyon (37c)
38 Bee Bee (38cd)
Blue Bell (38cd)
Turner and Geisendorfer mill site (38b)
Wild Canyon (38a)

Alphabetical

SIERRA COUNTY

(South of Latitude 39° 30')

25 Croesus
23,24 Dorriss
22 Evans prospect
21 Finan prospect
28 Flynn and Woods prospect
17 Luce & Co
26 Macchaus
27 McCormick prospect
18 Roupe

NEVADA COUNTY

24 Alta Hill
27 Baker prospect
11 Bartholomew-Summs lease
34 Bowden prospect
14 Champion mill
22 Codd prospects
26 Davey prospect
33 Dickerson
32 Dorsey and Ridge
18 Eden
4 Flintlock
30 Geach
3 Gillis prospect
29 Golden Gate
25 Grass Valley Extension
42 Half Chrome
23 Holseman
12 Maguire prospect
17 Merrifield
5 Moscatelli No. 1
2 Moscatelli No. 2
20 Mulcahy prospect
36 Numitor
10 Olsen prospect
13 Onstoman mill
19 Porter
7 Rapid Fire
8 Red Ledge
39 Rolpholm Ranch
37 Schmidt
31 Section 19 prospects
15 Sherman Ranch
35 Shrull prospect
40 Sleeman
28 Spring Hill
21 Standard
43 Sweet Ranch
41 Thompson Ranch
44 Tomkin lease
6 Turtledove Chrome
9 Victory
16 Waite
38 Weisgien
1 Williamson and Cole

PLACER COUNTY

1,2 Bear River Chrome
5 Beat
38 Bee Bee (38cd)
49 Bessie B.
90 Black Arrow Ranch
1 Black Nugget
79 Black Rock Chrome
81 Black Streak
38 Blue Bell (38cd)
34? Blue Jay (34a?)
11 Boiler Pit
87? Buckhorn
82 Bugg
67,68 Bunker
72 Buttercup Chrome
33,34 Buzzard (33a, 34b)
51 Capp's Pit
32 Chrome No. 5
78 Chrome Divide
75 Chromite
35 Chucho (35ab)
75 Clinton Burro
69 Coal Pit
21 Comeback (21c)
39 Daisy Belt
54 Dart and Braden's CAPCO lease (54a)
31 Dart and Braden mill site
84 Dodds Ranch prospect
8 Dunbar lease
46? Dunn's CAPCO lease
54? Dunn's CAPCO lease (54a)
20 Esther and Phyllis
19 Esther and Phyllis mill site
84-88 Farmer
88 Fiddler's Green
60-63 Finning property
86 Gas Canyon
85 Green
48 Green's CAPCO lease
49? Green's CAPCO lease
52-54 Green's CAPCO leases (52, 53ab, 54a)
58 Hayes Chrome
83 Hepburn
45 High-grade Pit
4 Hodge Ranch
30 Horseshoe
23-25 Iowa Hill Consolidated

EXPLANATION

Ultramafic rocks and serpentine

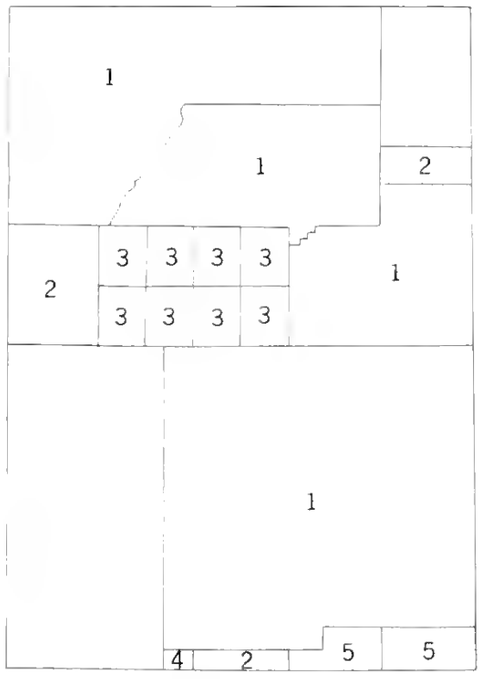
Contact, dashed where approximate

Margin of post-Cretaceous rocks overlying ultramafic rocks

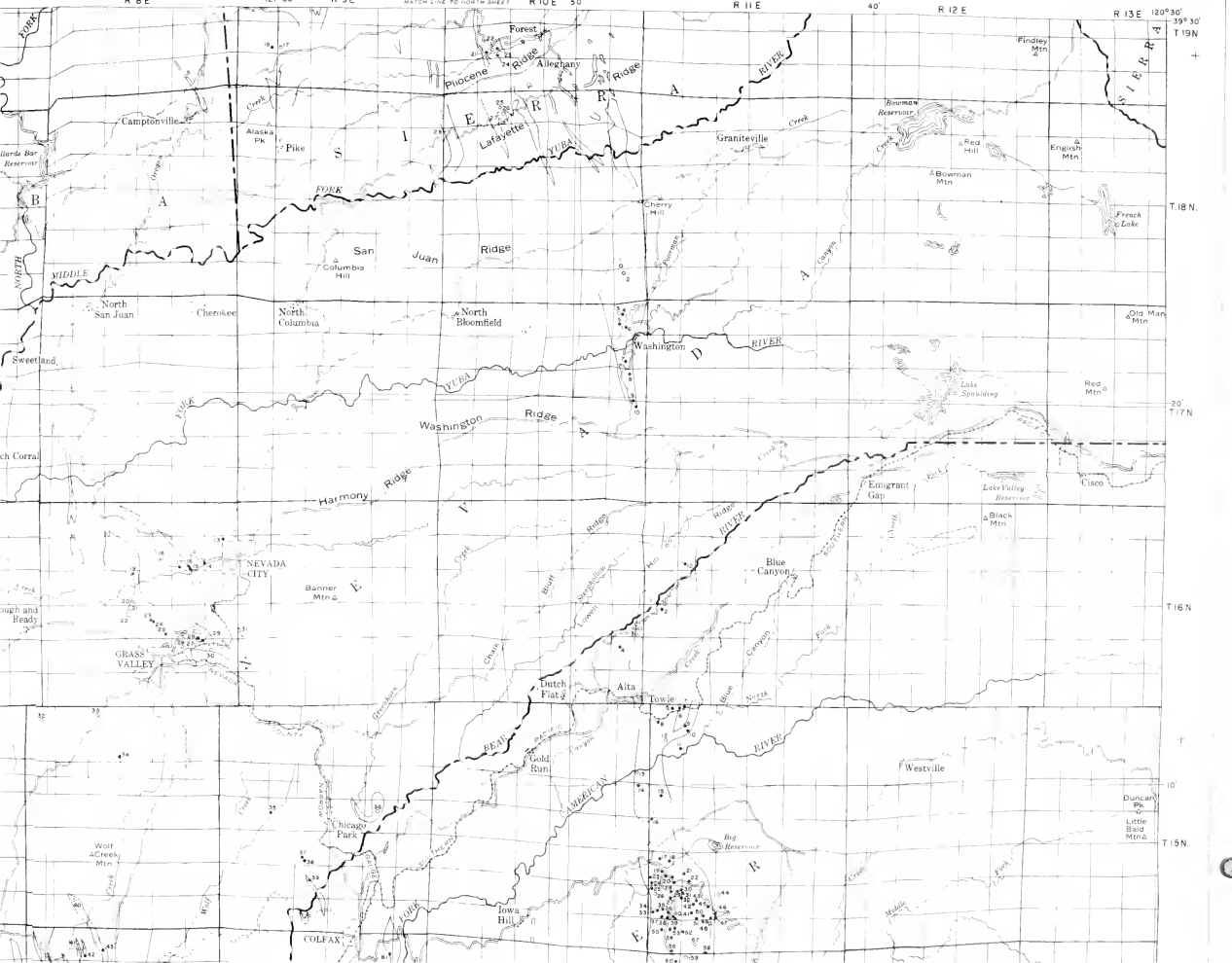
•12
Chromite deposit, accurately located

○21
Chromite deposit, approximately located

▲91
Former site of chromite stockpile



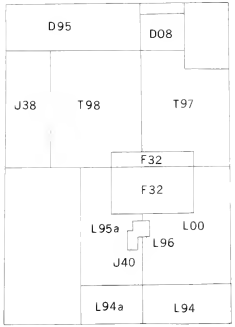
1. U. S. Forest Service, maps of Lassen, Plumas, and Tahoe National Forests.
2. U. S. Geological Survey, maps of Oroville, Blairsden, and Auburn 15' quadrangles.
3. U. S. Bureau of Reclamation, preliminary maps of Las Plumas, Brush Creek, Mooreville Ridge NW, Mooreville Ridge NE, Bidwell Bar, Forbestown, Clipper Mills, and Strawberry Valley 7½' quadrangles.
4. U. S. Corps of Engineers, map of Markham Ravine 15' quadrangle.
5. U. S. Forest Service, preliminary maps of Georgetown and Saddle Mtn. 15' quadrangles.


R 8E
121°00'
R 9E
MATCH LINE TO NORTH SHEET
R 10E
50'
R 11E
40'
R 12E
R 13E
120°30'
39°30'
T 19N
T 18N.
T 17N
T 16N
T 15N.
FORK
Forest
Pliocene Ridge
Allegheny
Ridge
RIVER
Findley Mtn
Bowman Reservoir
Red Hill
English Mtn
Bowman Mtn
French Lake
Camptonville
Alaska Pk
Pike
Lafayette
YUBA
Graniteville
Creek
Cherry Hill
San Juan Ridge
Columbia Hill
MIDDLE
NORTH
North San Juan
Cherokee
North Columbia
North Bloomfield
Washington
Old Man Mtn
Sweetland
Lake Spaulding
Red Mtn
Washington Ridge
Harmony Ridge
Emigrant Gap
Lake Valley Reservoir
Cisco
Black Mtn
NEVADA CITY
Banner Mtn
Blue Canyon
GRASS VALLEY
Dutch Flat
Alta
Towle
Gold Run
Westville
Duncan Pk
Little Bald Mtn
Chicago Park
Wolf
Creely Mtn
Big Reservoir
Iowa Hill
COLFAX

20 Fisher and Phyllis
21 Comeback (2)e1
Unidentified prospects (21ab)
22 Lucky Hunter
Sugar Lump
23-25 Iowa Hill Consolidated
26 Vulcan Consolidated (?)
27 Unidentified prospect
28 Randall Consolidated
29 Port Wine
30 Horseshoe
31 Dart and Braden mill site
32 Chrome No. 5
33 Buzzard (33a)
Lightning Streak No. 2 (33bde)
Sunny Ridge (33c)
34 Blue Jay (34a?)
Buzzard (34b)
35 Chucho (35ab)
Bald Canyon (35c)
36 Sunny Ridge Fraction
37 Lightning Streak No. 1 (37ab)
Wild Canyon (37c)
38 Bee Bee (38cd)
Blue Bell (38ed)
Turner and Geisendorfer mill site (38b)
Bald Canyon (38a)
39 Daisy Bell
40 Eleanor Bell
41 Hosler Pit
42 Unidentified prospect
43 Unidentified prospect
44 Unidentified prospect
45 Highgrade Pit
46 Dunn's (CAPCO lease (?)
Red Pit
47 Victors Chrome Co. mill site
48 Green's (CAPCO lease
49 Green's (CAPCO lease (?)
Long Pit
Yellow Pit
50 Twin Shafts
51 Apple's Pit
52 Green's (CAPCO lease
53 Green's (CAPCO lease (53ab)
Macalla's (CAPCO leases (53ab)
54 Dart and Braden's (CAPCO lease (54a)
Dunn's (CAPCO lease (54a?)
Green's (CAPCO lease (54a)
Macalla's (CAPCO lease (54a)
Sunset (54b)
55 Sunset
56 Kidder Pit
57 Little V. (?)
58 Hayes Chrome
59 Unidentified prospect
60-63 Finning property
64,65 Southern Pacific property
66 Schermer prospect
67,69 Bunker
69 Coal Pit
70 Mountain View group
71 Washout
72 Buttercup Chrome
73 Poco Tiempo Quartz
74 Spanish Mines Consolidated
75 Chromite
Clinton Burro
76 Lucky Boy
77 Little Greek
78 Chrome Divide
79 Black Rock Chrome
80 Lucky Strike
81 Black Sweak
82 Bugg
Major prospect
Meyer
83 Hepburn
84-88 Farmer
84 Dodds Ranch prospect
85 Green
86 Gas Canyon
87 Buckhorn (?)
88 Fiddler's Green
89 Parker Ranch
90 Black Arrow Ranch
91 Metals Reserve Co. stockpile site
92 Metals Reserve Co. purchasing depot
93 U. S. Vanadium Co. stockpile site
35 Chucho (35ab)
75 Clinton Burro
69 Coal Pit
21 Comeback (21e)
59 Danny Bell
54 Dart and Braden's CAPCO lease (54a)
31 Dart and Braden mill site
84 Dodds Ranch prospect
8 Dunbar Lease
167 Dunn's CAPCO lease
54? Dunn's CAPCO lease (54a)
20 Esther and Phyllis
19 Esther and Phyllis mill site
84-88 Farmer
88 Fiddler's Green
60-63 Finning property
86 Gas Canyon
85 Green
48 Green's CAPCO lease
49? Green's CAPCO lease
52-54 Green's CAPCO leases (52, 53ab, 54a)
58 Hayes Chrome
83 Hepburn
45 High-grade Pit
4 Hodge Ranch
30 Horseshoe
25-25 Iowa Hill Consolidated
9 Iron Spring
7 Julian
56 Kidder Pit
37 Lightning Streak No. 1 (37ab)
33 Lightning Streak No. 2 (33 bde)
77 Little Greek
57? Little V.
49 Long Pit
76 Lucky Boy
22 Lucky Hunter
80 Lucky Strike
80 Lucky Strike
82 Major prospect
53,54 Macalla's CAPCO leases (53ab, 54a)
92 Metals Reserve Co. purchasing depot
91 Metals Reserve Co. stockpile site
82 Meyer
70 Mountain View group
15 North Fork Chrome
10 Oak Patch
89 Parker Ranch
73 Poco Tiempo Quartz
79 Port Wine
28 Randall Consolidated
46 Red Pit
64 Schermer prospect
6 Scott
17 Section 19
16 Smith and McCollum prospect
11 Snakehead
64,65 Southern Pacific property
74 Spanish Mines Consolidated
22 Sugar Lump
33 Sunny Ridge (33c)
36 Sunny Ridge Fraction
54,55 Sunset (54b, 55)
38 Turner and Geisendorfer mill site (38b)
50 Twin Shafts
93 U. S. Vanadium Co. stockpile site
5 Uvarovite
47 Victory Chrome Co. mill site
26? Vulcan Consolidated
71 Washout
18 West Chrome
13 West prospect
35,37 Wild Canyon (35c, 37c)
38 Wild Canyon (38a)
49 Yellow Pit
27 Unidentified prospect
59 Unidentified prospect
18,21 Unidentified prospects (18, 21ab)
42-44 Unidentified prospects

Names listed under Placer

County shown on plate 3.



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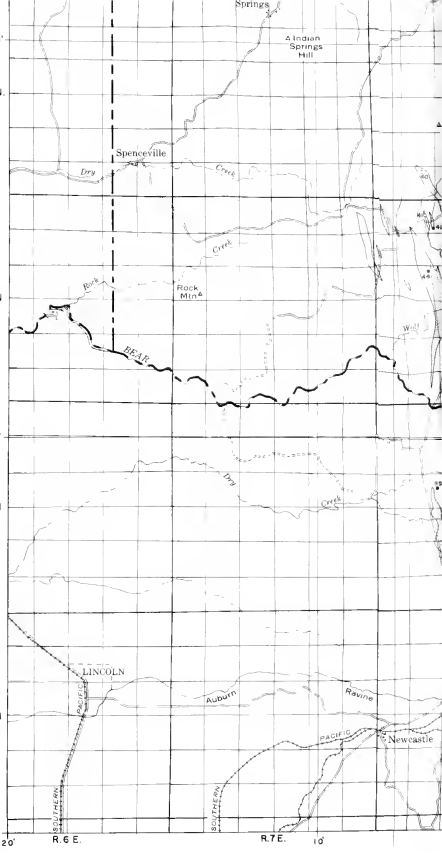
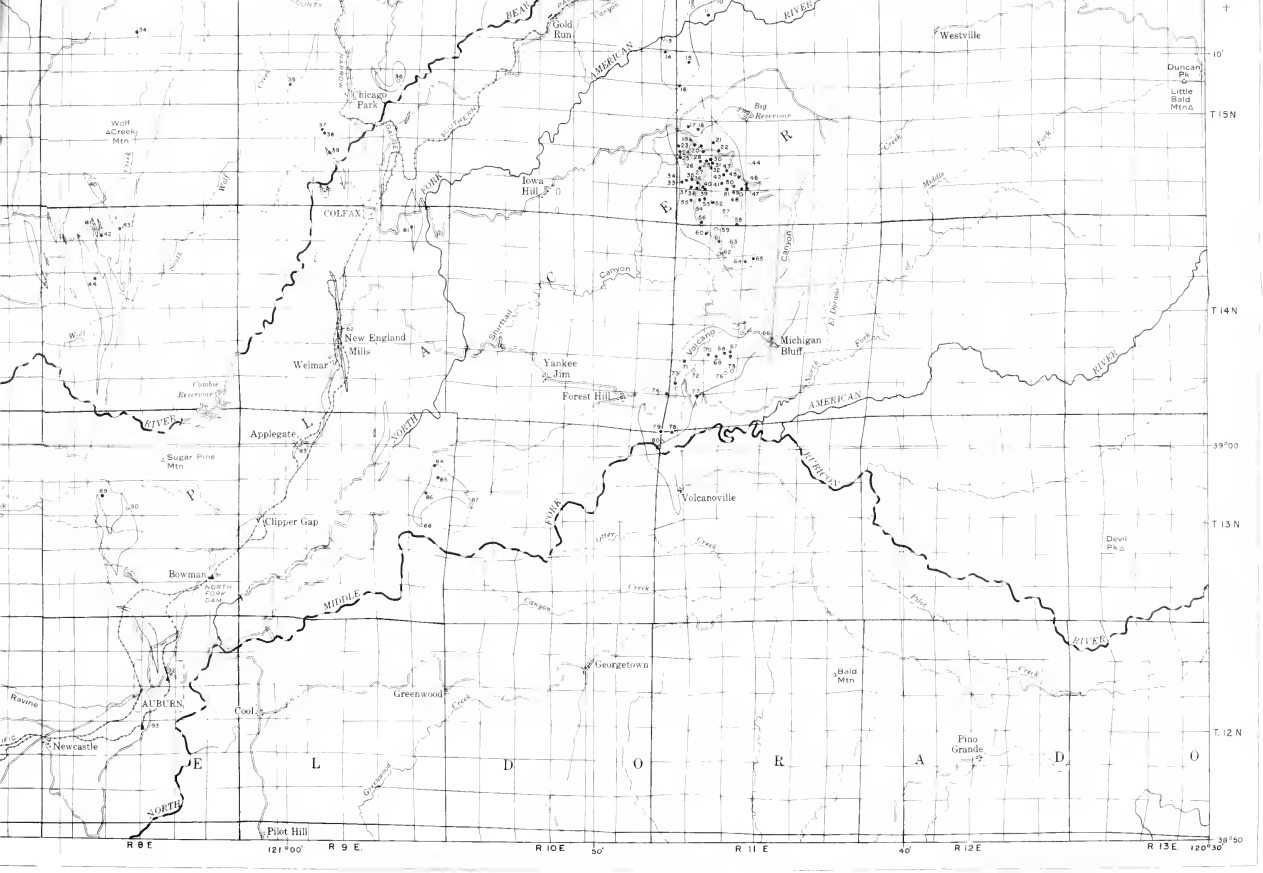
4. U. S. Corps of Engineers, map of Markham Ravine 15′ quadrangle.

5. U. S. Forest Service, preliminary maps of Georgetown and Saddle Mtn. 15′ quadrangles.

Geology was compiled by G. A. Rynearson from published geologic maps of areas shown on index map. Area symbols shown are keyed to the list of references in the text and represent the first letter of the author's surname followed by the last two digits of the year of publication. For example: J38 refers to "Jenkins, O. P., Geologic map of California,...California Div. Mines, 1938." Outlines of ultramafic masses shown on the original maps consulted have been modified somewhat to conform with features of revised base maps. Modifications were by inspection and/or projection and have not been checked in the field.



MAP OF PARTS OF
SHOWING

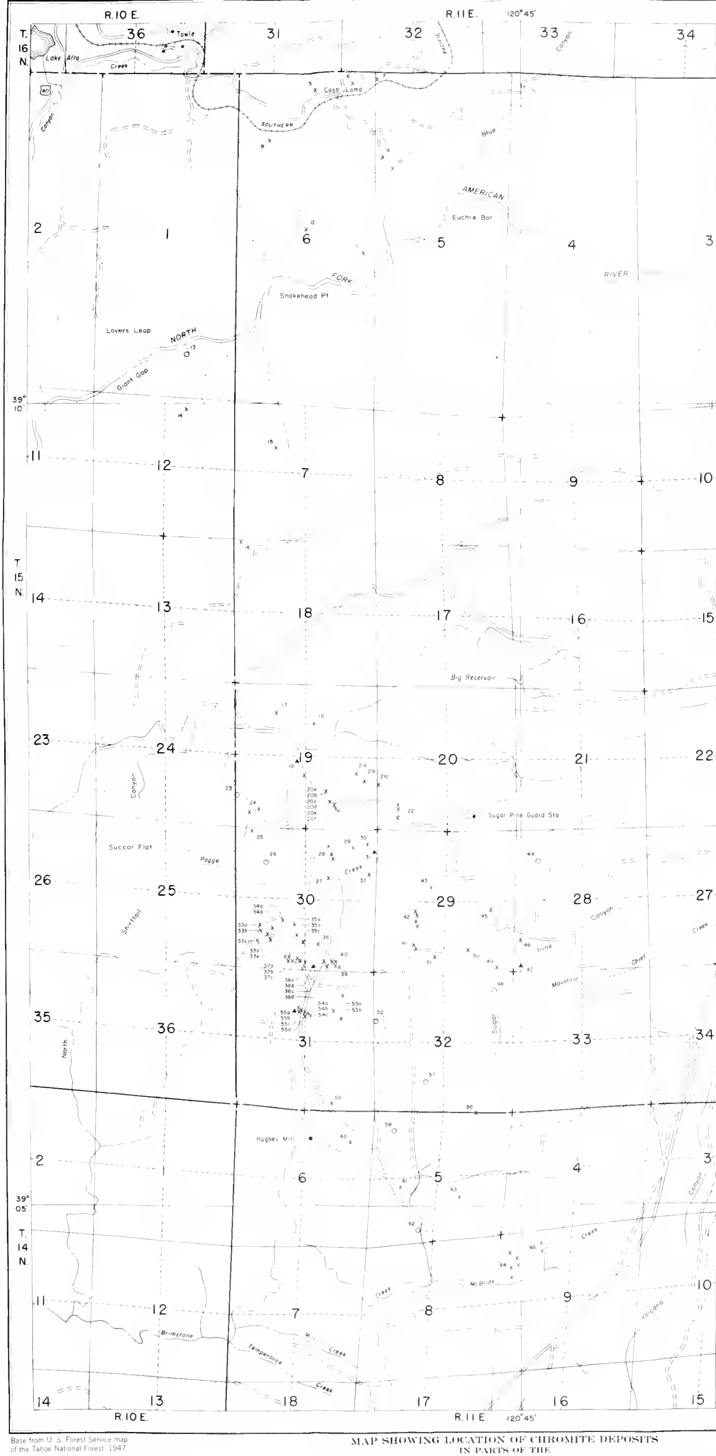


ARTS OF PLACER, NEVADA, SIERRA, YUBA, BUTTE, AND PLUMAS COUNTIES, CALIFORNIA

SHOWING DISTRIBUTION OF ULTRAMAFIC ROCKS AND LOCATION OF CHROMITE DEPOSITS

SOUTH SHEET

0 1 2 3 4 5 6 7 8 9 10 Miles



MAP SHOWING LOCATION OF CHROMITE DEPOSITS IN PARTS OF THE DUTCH FLAT AND FOREST HILL DIVIDE AREAS, PLACER COUNTY, CALIFORNIA

Base from U. S. Forest Service map of the Tahoe National Forest 1947

Compiled by G. A. Rynearson 1950

EXPLANATION

X Chromite deposits accurately located

○ Chromite deposits approximately located

▲ Site of concentrating plant

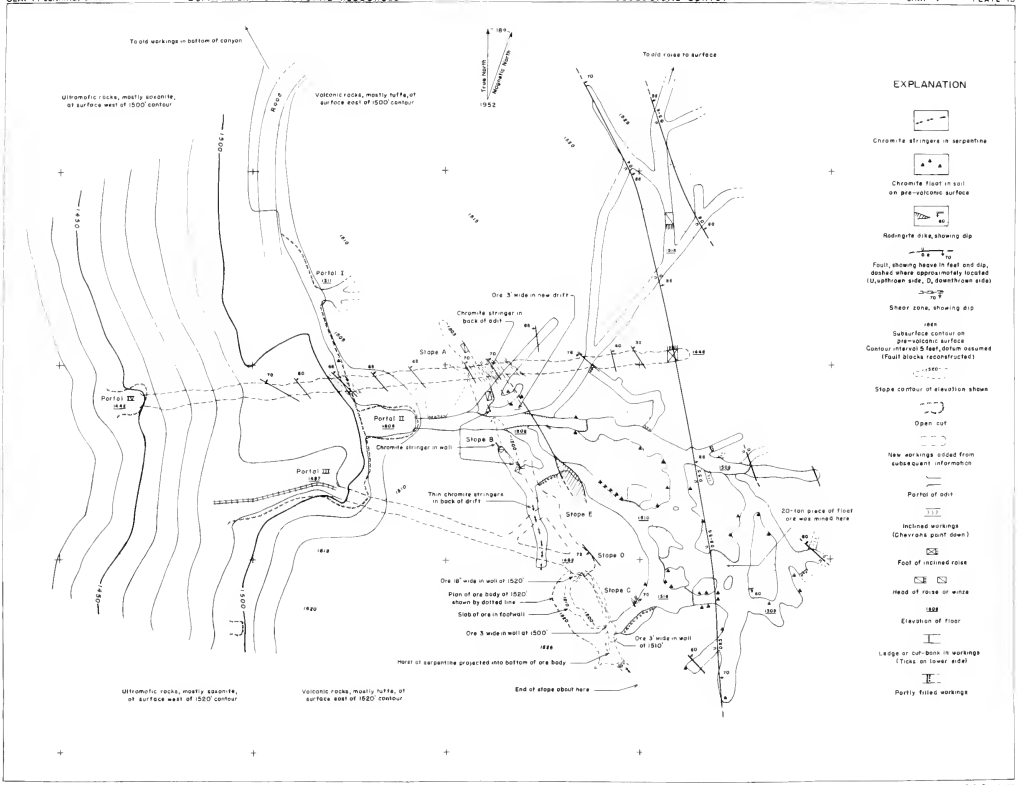
Identifying numbers correspond to those used on plate 13, letters appended to identify discrete deposits delineated on this plate.

INDEX TO MINES AND PROSPECTS

5. Heat
6. Scott
7. Julian
8. Dunbar lease
9. Iron Spring
10. Oak Patch
11. Snakehead (Jumbo)
12. Lucky Strike
13. West prospect
14. West Chrome
15. North Fork Chrome
16. Smith and McCollom prospect
17. Section 17
18. Unidentified prospect
20. Esther and Phyllis (a)
21. Unidentified prospects (a,b)
    Comeback (c)
22. Lucky Hunter and Sugar Loaf
23. Iowa Hill No. 1
24. Iowa Hill Nos. 2 and 3
25. Iowa Hill No. 2
26. Unidentified
27. Unidentified
28. Randall
29. Port Wine
30. Horseshoe
32. Chrome No. 7
33. Buzzard (a)
    Lightning Streak No. 1 (b,d,e)
    Sunny Ridge (c)
34. Buzzard (a,b)
35. Chucho (a,b)
    Wild Canyon (c)
36. Sunny Ridge Fraction
37. Lightning Streak No. 1 (a,b)
    Wild Canyon (c)
38. Wild Canyon (a)
    Bee Bee and Blue Bell (b,d)
39. Daisy Bell
40. Bessie B.
41. Butler Pit
42. Unidentified prospects
43. Unidentified prospect
44. Unidentified prospect
45. High-grade Pit
46. Red Pit
48. Green's CAPCO lease
49. Long Pit and Yellow Pit
50. Twin Shafts
51. Capp's Pit
52. Green's CAPCO lease
53. Marolls' CAPCO lease (a,b)
    Green's CAPCO leases (a?,b)
54. Dart and Braden's CAPCO lease (a)
    Green's CAPCO lease (a-c)
    Marolls' CAPCO lease (a-c)
55. Sunset (a,c,d)
56. Kidder Pit
57. Unidentified
58. Hayes Chrome
59. Unidentified
60. Fanning property
61. Fanning property
62. Pitt?
63. Unidentified
64. Southern Pacific property
65. Southern Pacific property

INDEX TO CONCENTRATING PLANTS

19. Esther and Phyllis
31. Dart and Braden
38. Turner and Gerwendorfer (c)
47. Victory Chrome Co.
55. Sunset (b)



Surveyed by G. A. Rynearson and F. L. Gilliland
September 1949

Geology by G. A. Rynearson
September 1949

COMPOSITE GEOLOGIC MAP OF THE MAIN WORKINGS OF THE LAMBERT CHROMITE MINE, BUTTE COUNTY, CALIFORNIA

0 50 100 150 200 Feet

Surface contour interval 10 Feet
Datum assumed